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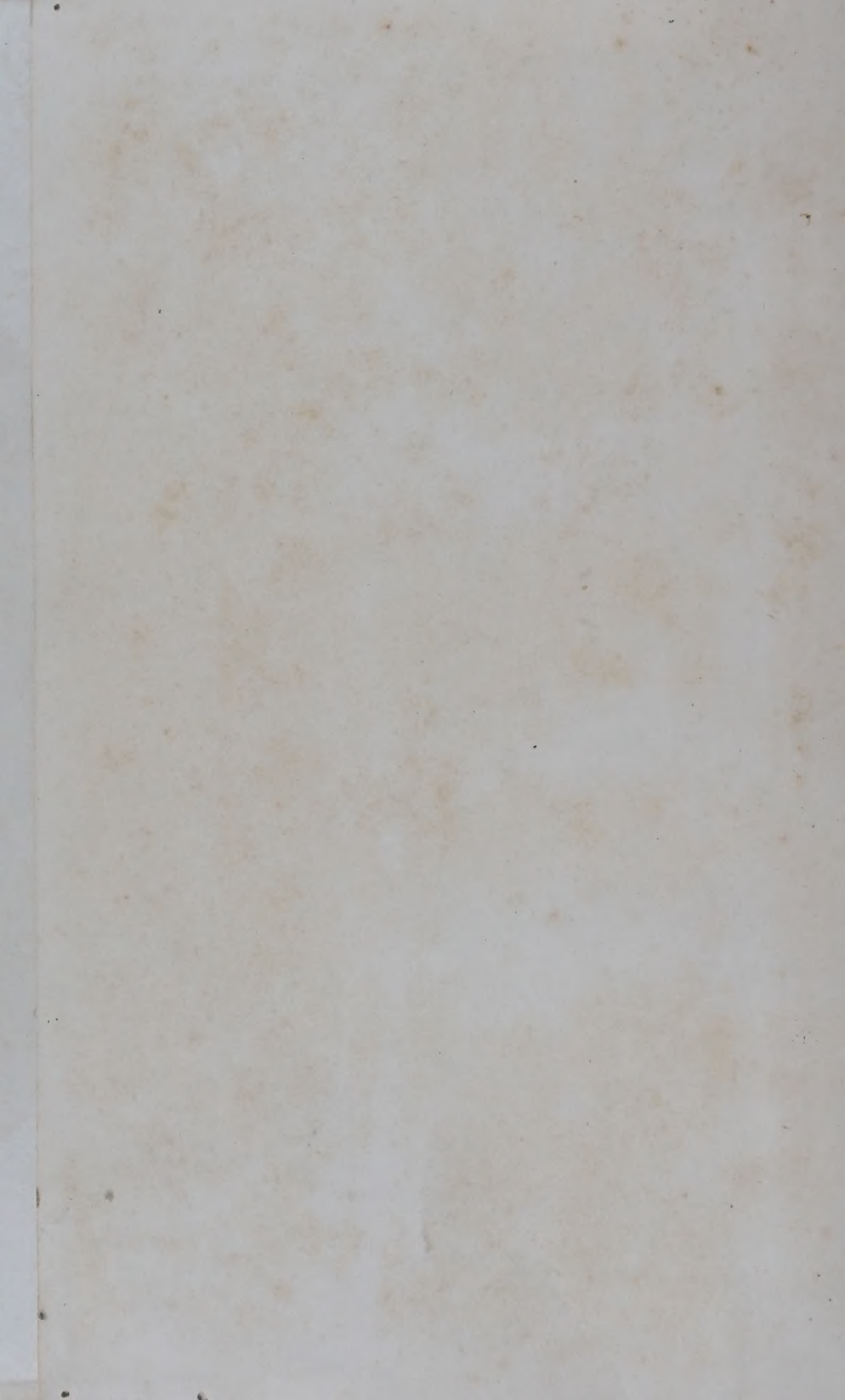










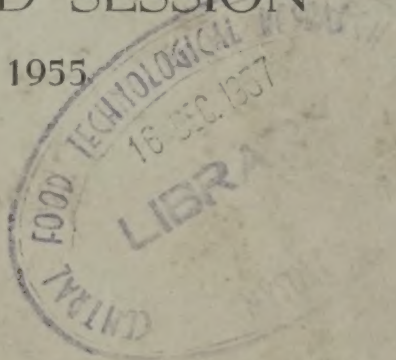




# INDIAN SCIENCE CONGRESS ASSOCIATION

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PROCEEDINGS  
OF THE  
FORTY-SECOND SESSION  
BARODA 1955



PART III  
ABSTRACTS









# PROCEEDINGS OF THE FORTY-SECOND INDIAN SCIENCE CONGRESS

## PART III—ABSTRACTS

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*Ishwari*



# PROCEEDINGS OF THE FORTY-SECOND INDIAN SCIENCE CONGRESS

## PART III-ABSTRACTS

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# 42nd INDIAN SCIENCE CONGRESS, BARODA, 1955

## SECTION OF MATHEMATICS

PRESIDENT : B. R. SETH, M.A., Ph.D., D.Sc.

### Abstracts

#### 1. Difference Theorem for the Construction of Hierarchical Group Divisible Incomplete Block Designs.

P. M. ROY, Calcutta

*Theorem :* Let  $M$  be a module with  $v$  elements  $0, 1, \dots, v-1 \pmod{v}$ . To each element  $e$  of the module  $M$  let there correspond  $\mu$  varieties  $e_i$ , ( $i=1, 2, \dots, \mu$ ), the elements  $e_i$  ( $e=0, 1, \dots, v-1$ ) and the corresponding varieties being known as the elements and the varieties belonging to the  $i$ -th class. To the  $\mu v$  varieties thus obtained let us adjoin  $p$  invariant elements  $I_i$ , ( $i=1, 2, \dots, p$ ) each representing a new variety. Let us divide the  $\mu v + p = v$  varieties into  $N_1$  groups of  $S_1$  varieties each at the first stage,  $S_1$  varieties of a group of the first stage into  $N_2$  groups of  $S_2$  varieties each at the second stage and so on till the  $(m-2)$ -th stage when  $S_{m-2}$  varieties of a group are divided into  $N_{m-1}$  groups of  $S_{m-1}$  varieties each at the  $(m-1)$ -th stage, such that by adding any element of the module  $M$  to each element of a group of the  $(m-1)$ -th stage we get back the same group if it contains one or more invariant elements, and any one of the groups (including the group itself) belonging to the same group of the  $(m-2)$ -th stage but not containing any invariant element when the group itself does not contain any. It is possible to choose  $t$  sets of  $k$  elements each (i.e.,  $t$  blocks of  $k$  varieties each) satisfying some conditions, and the development of the  $t$  initial sets  $\pmod{v}$  would then lead to a HGD design with  $m$ -associate classes.

#### 2. On the Summability Factors of a Fourier Series.

B. N. PRASAD AND S. N BHATT, Allahabad

The idea of summability factors applicable to Fourier series developed by Prasad (*Proc. Lond. Math. Soc.*, **35**, 1933, 407-424), Izumi, Kwata, Chow, Cheng and others has been extended and a number of theorems proved. A typical one is the following:

If

$$\{[\log(n+1)]^{1+\beta} \lambda_n\}$$

is a convex sequence such that the series

$$\sum n^{-1} \{\log(n+1)\}^{1+\beta} \lambda$$

is convergent, and for  $\beta \geq 0$

$$\int_0^t \varphi(u) = O\left\{t \left(\log \frac{1}{t}\right)^\beta\right\}$$

as  $t \rightarrow 0$ , then the series  $\sum \lambda_n C_n(x)$  is summable  $|C.1|$  at the given point  $x$ .



### 3. On the Logarithmic mean of the Derived Conjugate series of a Fourier Series.

R. MOHANTY AND M. NANDA, Cuttack

Let  $f(t)$  be integrable  $L$  in  $(-\pi, \pi)$  and periodic with period  $2\pi$  and let

$$f(t) \sim \frac{1}{2} a_0 + \sum_1^{\infty} (a_n \cos nt + b_n \sin nt) = \frac{1}{2} a_0 + \sum_1^{\infty} A_n(t) \quad (1)$$

The conjugate series of (1) at  $t=x$  is

$$\sum_1^{\infty} (b_n \cos nx - a_n \sin nx) = \sum_1^{\infty} B_n(x) \quad (2)$$

Then the differentiated series of (2) is

$$-\sum_1^{\infty} n(a_n \cos nx + b_n \sin nx) = -\sum_1^{\infty} nA_n(x) \quad (3)$$

We write

$$\phi(t) = f(x+t) + f(x-t) - 2f(x), h(t) = \frac{\phi(t)}{4 \sin \frac{1}{2}t} - d, \text{ where } d \equiv d(x).$$

Let  $\sigma_n$  be the first logarithmic mean of the series (3).

Then the following Theorem has been proved.

*Theorem.* If

$$\int_t^{\pi} \frac{|h(u)|}{u} du = O\left(\log \frac{1}{t}\right), \text{ as } t \rightarrow 0$$

then

$$\lim_{n \rightarrow \infty} (\sigma_2 - \sigma_n) = \frac{d}{\pi} \log 2.$$

### 4. On the Absolute Logarithmic Summability of Fourier series and its Differentiated series.

R. MOHANTY AND S. MOHAPATRA, Cuttack.

1. Let  $f(t)$  be integrable  $L$  in  $(-\pi, \pi)$  and periodic with period  $2\pi$  and let

$$f(t) \sim \frac{1}{2} a_0 + \sum_1^{\infty} (a_n \cos nt + b_n \sin nt) = \frac{1}{2} a_0 + \sum_1^{\infty} A_n(t) \quad (1.1)$$

Then the series obtained by formally differentiating (1.1) at  $t=x$  is

$$\sum n(b_n \cos nx - a_n \sin nx) = \sum n B_n(x). \quad (1.2)$$

We write

$$\phi(t) = \frac{1}{2} \{ f(x+t) + f(x-t) - 2f(x) \}, \quad (1.3)$$

$$\psi(t) = \frac{1}{2} \{ f(x+t) - f(x-t) \}, \quad (1.4)$$

$$g(t) = \frac{\psi(t)}{t}, \quad (1.5)$$

$$\lambda(t) = \int_t^{\pi} \frac{\phi(u)}{u} du, \quad (1.6)$$

$$\theta(t) = \int_t^{\pi} \frac{g(u)}{u} du. \quad (1.7)$$

The following two theorems have been proved :

*Theorem A.* If  $\frac{\lambda(t)}{\log \frac{k}{t}}$  is  $V$  in  $(0, \pi)$ , then (1.1) is summable  $|R, \log w, 2|$  at the point  $t=x$ .

*Theorem B.* If  $\frac{\theta(t)}{\log \frac{k}{t}}$  is  $V$  in  $(0, \pi)$  then (1.2) is summable  $|R, \log w, 2|$ .

## 5. On the non-summability of the Conjugate series of a Fourier series.

S. R. SINHA, Allahabad.

1. Let  $f(\theta)$  be a periodic function with a period  $2\pi$  and integrable- $L$  in  $(-\pi, \pi)$ . Let the Fourier Series of  $f(\theta)$  be

$$\frac{1}{2}a_0 + \sum_{n=1}^{\infty} (a_n \cos n\theta + b_n \sin n\theta). \quad (1.1)$$

Then the conjugate series of the Fourier Series is given by

$$\sum_{n=1}^{\infty} (b_n \cos n\theta - a_n \sin n\theta) \quad (1.2)$$

and the conjugate function, defined as a Cauchy integral, is given by

$$g(\theta) = \frac{1}{2\pi} \lim_{\varepsilon \rightarrow 0} \int_{\varepsilon}^{\pi} \psi(u) \cot \frac{1}{2}u \, du,$$

where

$$\left. \begin{aligned} \psi(u) &= f(\theta+u) - f(\theta-u), \\ \Psi_{\alpha}(t) &= \frac{1}{\Gamma(\alpha)} \int_0^t (t-u)^{\alpha-1} \psi(u) du, \quad \alpha > 0; \\ \Psi_0(t) &= \psi(t); \\ \psi_{\alpha}(t) &= \Gamma(\alpha+1) t^{-\alpha} \Psi_{\alpha}(t), \quad \alpha \geq 0. \end{aligned} \right\} \quad (1.4)$$

2. Plessner (Mitteilungen der Mathematischen Seminars der Universitat Giessen, vol. 10, 1923, pp. 1-36) has proved the following theorem :

*Theorem :* Let

$$V(x, \theta) = \sum_{n=1}^{\infty} (b_n \cos n\theta - a_n \sin n\theta) x^n, \quad (0 \leq x < 1). \quad (1.5)$$

Then, if for any  $\theta$ , the condition

$$\int_0^t \psi(t) dt = 0(t) \quad (2.1)$$

is satisfied, then

$$\lim_{x \rightarrow 1} \left[ V(x, \theta) - \frac{1}{2\pi} \int_{\varepsilon}^{\pi} \psi(t) \cot \frac{1}{2}t \, dt \right] = 0$$



It follows immediately from this theorem that if condition (2.1), holds then the divergence to  $+\infty(-\infty)$  of the conjugate function (1.3) is a necessary and sufficient condition for the divergence of the Abel-limit of the Conjugate series to  $+\infty(-\infty)$ .

3. In this paper Plessner's theorem is generalised by replacing the condition (2.1) by the less stringent condition

$$\psi_\alpha(t)=0(1); \text{ as } t \rightarrow 0, \quad \alpha \text{ being a positive integer } \geq 1. \quad (3.1)$$

6. On the Absolute Riesz Summability of Fourier series, its Conjugate series and their Derived series.

T. PATI, Allahabad.

1. Let  $f(t)$  be a periodic function with period  $2\pi$  and integrable ( $L$ ) over  $(-\pi, \pi)$ . Without any loss of generality the Fourier series of  $f(t)$  may be assumed to be

$$\sum_1^\infty (a_n \cos nt + b_n \sin nt).$$

Then the conjugate series of the Fourier series of  $f(t)$  is given by

$$\sum_1^\infty (b_n \cos nt - a_n \sin nt).$$

The following notations are used.

$$\varphi(t) = \frac{1}{2} [f(x+t) + f(x-t)],$$

$$\psi(t) = \frac{1}{2} [f(x+t) - f(x-t)],$$

$$P(t) = \sum_{i=0}^{r-1} (\theta_i t^i / i!),$$

where the  $\theta$ 's are arbitrary;

$$g(t) = \frac{1}{2} [\{f(x+t) - P(t)\} + (-1)^r \{f(x-t) - P(-t)\}],$$

$$h(t) = \frac{1}{2} [\{f(x+t) - P(t)\} - (-1)^r \{f(x-t) - P(-t)\}],$$

$$\Phi_\sigma(t) = \frac{1}{\Gamma(\sigma)} \int_0^t (t-u)^{\sigma-1} \varphi(u) du, \quad \sigma > 0,$$

$$\Phi_0(t) = \varphi(t),$$

$$\varphi_\sigma(t) = \Gamma(\sigma+1) t^\sigma \Phi_\sigma(t), \quad \sigma \geq 0,$$

$\Psi_\sigma(t)$ ,  $\psi_\sigma(t)$ ,  $G_\sigma(t)$ ,  $g_\sigma(t)$ ,  $H_\sigma(t)$  and  $h_\sigma(t)$  have similar meanings;

$$\gamma_{\alpha,r}(t) = g_{\alpha-r}(t)/t^r, \quad \theta_{\alpha,r}(t) = h_{\alpha-r}(t)/t^r, \quad e(\omega) = \exp\{(\log \omega)^{1+1/\alpha}\}.$$

2. Let  $\sum_1^\infty a_n$  be a given infinite series, and  $\lambda_n$  a positive monotonic increasing function of  $n$ , steadily tending to infinity with  $n$ . Writing

$$A_\lambda(\omega) = A_{\lambda^0}(\omega) = \sum_{\lambda_n \leq \omega} a_n$$

and

$$A_\lambda^r(\omega) = \sum_{\lambda_n \leq \omega} (\omega - \lambda_n)^r a_n,$$

the series  $\sum a_n$  is said to be summable  $|R, \lambda, r|$ ,  $r \geq 0$ , if  $A_\lambda^r(\omega)/\omega^r$  is of bounded variation in  $(A, \infty)$ , where  $A$  is a finite positive number.

3. In a paper under publication in the Transactions of the American Mathematical Society the author has established four theorems of a very general character concerning the summability  $|R, e(\omega), \alpha+1|$  of Fourier series, its conjugate series and their derived series. These results have been improved by replacing the order of summability by the more precise order  $\alpha+\delta$ ,  $0<\delta<1$ , and a number of theorems have been established.

## 7. On Strong Rieszian Summability of Infinite Series.

(Kumari) PRAMILA SRIVASTAVA, Allahabad.

The notion of strong summability of infinite series has been considered by Fekete Hardy and Littlewood, Winn, U. N. Singh and others. Starting with the Rieszian mean of the given series, strong *Rieszian* summability is defined as follows :

$$\int_{\lambda_0}^x |C_{\lambda}^{k-1}(t) - S|^q dt = o(x)$$

where  $C_{\lambda}^{k-1}(t)$  is the Riesz mean of order  $k-1$  type  $\lambda$  associated with the series  $\sum a_n$ , and we say that  $\sum a_n$  is strongly summable by Riesz means of order  $k$  type  $\lambda$  with index  $q$ , or simply summable  $(R, \lambda, k, q)$  to the sum  $S$  ( $k>0, q>0$ ).

## 8. On The Determination of the Jump of a Function by Its Fourier Series.

SULAXANA KUMARI, Allahabad.

Let  $f(t)$  be a function integrable in the Lebesgue sense over  $(-\pi, \pi)$  and periodic with period  $2\pi$ . Let the Fourier series associated with  $f(t)$  be

$$f(t) \sim \frac{a_0}{2} + \sum_{n=1}^{\infty} (a_n \cos nt + b_n \sin nt),$$

Then its conjugate series at  $t=x$  is

$$\sum_{n=1}^{\infty} (b_n \cos nx - a_n \sin nx) = \sum_{n=1}^{\infty} B_n(x)$$

Let

$$\psi(t) = \frac{1}{2} \{ f(x+t) - f(x-t) \}$$

$$\theta(t) = \psi(t) - l$$

$$\psi_{\alpha}(t) = \frac{\alpha}{t^{\alpha}} \int_0^t (t-u)^{\alpha-1} \psi(u) du$$

In this paper a result recently obtained by Mohanty and Nanda for the case,  $\alpha=0$  (*Proc. American Math. Soc.*, 5, (1954), 79-84, Theorem 1) has been extended to the case  $\alpha>0$

## 9. Exceptional values B and E of Meromorphic functions of infinite order.

S. M. SHAH, Aligarh

In a recent paper (*Duke Math. J.*, 19, (1952), 585-594) I have proved that if  $f(z)$  be a meromorphic function of finite order having  $a_1$  and  $a_2$  as values exceptional B then  $a_1$  and  $a_2$  are also values exceptional E. In this paper I prove this result for meromorphic functions of infinite order.



G. Valiron has constructed a function (Comptes Rendus des seances de l'Academie des sciences, Paris, 225 (1947), 556-8) for which infinity is a *v.e. B.* but not *e. N.* In this paper I construct another function for which infinity is a *v.e.B.* but not *e.N.* or *e.E.*

## 10. Multiquadrant Graphs for functions of $n$ -variables :

K. P. NANDY, Khargpur.

A generalised method of construction of graphs for functions of  $n$ -variables is developed. The given mathematical formula is rearranged in the form

$$F = \dots \psi_2[\psi_1[\phi \times \phi_1 + \chi] \times \xi] + \eta \dots \text{ where } \phi, \phi_1, \chi, \xi, \eta \dots$$

are single-valued continuous functions of independent variables. A sheet of graph paper is divided into a number of adjacent quadrants which may be well above 4. By performing graphically the four fundamental operations of arithmetic *viz.*, addition, subtraction, multiplication and division with the help of sets of curves in the quadrants and by drawing functional graphs wherever necessary, the graph for the function  $F$  is completed step by step. An arbitrary numerical example is taken to illustrate some practical considerations during the preparation of a multiquadrant graph.

## 11. Some Consequences of a Theorem of Darboux.

P. K. GHOSH, Calcutta.

As a consequence of a well-known theorem of Darboux, the Intermediate Value Theorem for a single-real-valued function of a real variable has been generalized to hold under a condition weaker than continuity of the function in a closed interval. The Intermediate Value Theorem for a continuous function has been obtained as a special case, thus establishing that the Intermediate Value Theorem for a continuous function is but a consequence of the Weierstrassian property of a continuous function attaining its bounds. Rolle's theorem has also been obtained as a consequence of the theorem of Darboux.

## 12. Moebius Tetrads

SAHIB RAM MANDAN, Kharagpur.

An incomplete model of a pair of Moebius Tetrads served as a hanger till the following chain of observations made its construction simple and led to a treasure of very interesting results enumerated below and treated both synthetically as well as analytically.

1. A Quadric  $Q_1$  is discovered\* interlocked with a pair of Moebius Tetrads  $T_0$  &  $T_1$  that leads to the construction of infinity of Mutually Interlocked Tetrads, all further interlocked with  $Q_1$ . Again sets of four pairs of Moebius Tetrads are observed, each set having the same eight vertices.
2.  $T_0$  is harmonically inverse to  $T_1$  w.r.t. a pair of skew generators of the Quadric  $Q$  for which  $T_0$ ,  $T_1$  and  $Q_1$  are self-polar. These generators form a pair of polar lines for  $Q_1$ .
3. There are two pairs of polar lines, for  $Q_1$ , upon which lie the vertices, one on each, of a third Tetrad  $T_2$  that is interlocked with  $T_0$  &  $T_1$  independent of the infinity of Tetrads of para 1. Given one vertex,  $T_2$  is uniquely determined.

4.  $T_i$  ( $i=0,1,2$ ) give rise to another Tetrad  $T_i$  forming a set of four Mutually Interlocked Tetrads that introduce further another set of four such Tetrads having the same sixteen vertices (faces) that lie (touch) by sixes on (—) sixteen conics (Cones), one in (through) each face (vertex), having common with one another a pair of vertices (faces as tangent planes). The eight Tetrads of the two sets are all self-polar w.r.t.  $Q$ . There exist thirtysix Quadrics out-polar (inpolar) to  $Q$ , each one passing through (enveloping) four conics (cones) and twelve vertices (faces) that form two pairs of Moebius Tetrads, one pair from each set. Nine Quadrics pass through (envelop) each conic (cone).
5. There are six Quadrics of the type  $Q_2$ , for the set of Tetrads  $T_i$  ( $i=0,1,2,3$ ), one for each pair, that all have a fixed pair of skew generators common with  $Q$ . The same is the case with the 2nd set.

### 13. On a generalisation of a 3-dimensional space of Constant Curvature and of Clifford's parallelisms.

R. N. SEN, Calcutta.

Let  $\xi^i$  and  $\zeta^i_\alpha$  be a pair of orthogonal ennuples in a metric space and let them define a pair of teleparallelisms with coefficients of affine connections  $\xi^i_\alpha \frac{\partial \xi^j_\alpha}{\partial x^k}$  and  $\zeta^i_\alpha \frac{\partial \zeta^j_\alpha}{\partial x^k}$ .

If the parallelisms are Clifford's parallelisms in a 3-dimensional space of constant curvature, then (1) the vectors of the two ennuples generate two reciprocal simply transitive groups of continuous transformations and (2) each vector of the ennuples generates infinitesimal motion which preserves distance. The generalisation given in the paper is a 3-dimensional space in which the orthogonal ennuples defining the teleparallelisms have the property that if the vectors of one of the ennuples generate a simply transitive group of continuous transformations, then the condition (1) stated above is satisfied, and that if one of the above two conditions (1) or (2) holds, the other also holds. It is seen that, as in the case of Clifford's parallelisms, the vectors  $\xi^i_\alpha$  and  $\zeta^i_\alpha$  of the ennuples make constant difference of cosines of angles with any geodesic and make the space a Cartan's symmetric space.

### 14. On a Type of Metric Space

M. C. CHAKI, Calcutta.

In his paper 'On certain associated metric spaces' (Journal of the faculty of the graduate school of Pennsylvania University, Philadelphia, 1934) Lovell started with an Einstein space of non-zero scalar curvature and showed that corresponding to such a space there was an associated Einstein space whose fundamental tensor was the Ricci tensor of the original space. In that paper he considered the associated space and studied the effect on the original space of the assignment of certain properties to the associated space. In the present paper we start with a Riemannian space homogeneous with respect to a tensor  $F_{ij}$  where  $F_{ij} = g^{mn} F_{imnj}$  and  $F_{imnj}$  is any tensor satisfying all the identities of the Riemann tensor except the cyclic one. It has been shown that for such a space there exists an associated Riemannian space whose fundamental tensor is the tensor  $F_{ij}$ . Further, the effect produced on any one of the spaces due to the imposition of certain properties on the other has been studied and some interesting results have been obtained.



## 15. On some Spherically Symmetrical Models in Relativity.

R. V. WAGH, Poona.

For a line-element for a Spherically symmetrical model it is shown that solutions of the form

$$i. \quad e^{\mu} = \frac{R^2}{c^2(1+kr^2/4)^2}, \text{ where } R \text{ is a function of time,}$$

and

$$ii. \quad e^{\mu} = \frac{e^{\theta(t)}}{(1+r^2/4R_0^2)^2}$$

can be obtained directly from the condition of spatial isotropy, namely

$$e^{\mu/2} (\mu'' - \frac{1}{2}\mu'^2 - \frac{1}{r}\mu') = \phi(r) \quad (i)$$

Other solutions are also shown to be possible particularly of the form (a)  $e^{\mu} = (ax+b)^{-2}$ , where "a" and "b" are constants and (b)  $e^{-\mu} = f$ , where  $x = t^2 - r^2/c^2$  and

$$f = 1 + \sqrt{3} \cdot \frac{C_n(ax+b)-1}{C_n(ax+b)+1} \quad (ii)$$

For a line-element of the form

$$ds^2 = -e^{\lambda}dr^2 - r^2d\theta^2 - r^2 \sin^2\theta d\phi^2 + e^{\nu}dt^2,$$

which gives a spherically symmetrical model, one gets an isotropic solution given by

$$\text{and } \left. \begin{aligned} e^{-\lambda} &= 1 - m^2r^4, \\ e^{\nu} &= A^2 \cos^2\left\{\frac{1}{2} \sin^{-1}(mr^2) + \alpha\right\} \end{aligned} \right\} \quad (iii)$$

16. On the Solution of  $\Gamma$ 's for a Type of Non-static Unitary Field  $g_{\mu\nu}$ .

N. N. GHOSH, Calcutta.

The general solution of the system of 64 equations

$$g_{\mu\nu,\sigma} = g_{\mu\lambda}\Gamma_{\sigma\nu}^{\lambda} + g_{\lambda\nu}\Gamma_{\mu\sigma}^{\lambda}$$

for non-symmetric  $\Gamma_{\mu\nu}^{\alpha}$ , corresponding to a general non-symmetric tensor field  $g_{\mu\nu}$ , as obtained by Bose, Einstein and Kaufman, Hlavaty is naturally much complicated when expressed explicitly in terms of  $g_{\mu\nu}$  and its first derivatives. Moreover, "Such a solution is not of any practical utility for solving differential equations". But for special types of non-symmetric field  $g_{\mu\nu}$  with certain restrictive assumptions the solution which holds for a general coordinate system comes out in a much simpler form and it is the object of this paper to study three mutually allied cases and to compute the corresponding Hermitianized Einstein tensor  $R_{\mu\nu}$ .

## 17. Reformulation of the Field Equations of the Unified Field Theory.

P. C. VAIDYA, Vallabh Vidyanagar

In the current formulation of the field equations of the unified field theory, the determinant  $g$  of the fundamental non-symmetric tensor  $g_{ik}$  is assumed to be non-zero.

This is a mathematical assumption. In the present paper the same field equations are rederived in such a manner that this assumption is not necessary. In the new formulation the tensor density  $g^{ik}$  becomes fundamental and the field equations determine this density in either of the two cases :

$$(1) \quad \det | g^{ik} | = 0 ; \qquad (2) \quad \det | g^{ik} | \neq 0.$$

In the latter case the field equations can be expressed in the current form.

An explicit static spherically symmetric solution is derived. This solution has  $\det | g^{ik} | = 0$  and hence it is distinct from the solutions already known. This solution may be made to correspond to the line-element in general relativity

$$ds^2 = -e^{\lambda} dr^2 - \frac{1}{r^2} (r^2 d\theta^2 + r^2 \sin^2 \theta d\varphi^2) + e^{\nu} dt^2.$$

This line-element cannot be transformed into the usual forms of line-elements indicating spherical symmetry. The physical content of such line-elements in the scheme of general relativity is at present being investigated.

## 18. Stability of Rectilinear Plates.

B. R. SETH, Kharagpur.

It is shown that the critical thrust for the stability of a simply supported rectilinear plate under the combined action of transverse load and edge thrust corresponds to the least eigen value for the transverse vibrations of a clamped plate having the same boundary as that of the plate. Some cases of triangular plates are discussed in detail.

## 19. Stress distribution around circular holes in cylindrically aeolotropic plates.

A. M. SEN GUPTA, Sibpur

The problem of a cylindrically aeolotropic elastic plate containing a single circular hole under various types of unbalanced prescribed load in the plane of the plate, which is otherwise infinite, and acting on the boundary of the hole has been discussed. A general solution for any given unbalanced distribution of tractions in the plane of the plate and applied at the periphery of a circular hole is obtained. Particular cases corresponding to those engineering problems of isotropic plates which have been verified by photo-elastic experiments, as also those that are most likely to arise in Engineering practice, are considered. In all these cases the stresses are obtained in infinite series, which are easily seen to be uniformly convergent, while the stresses in the simple case when the non-zero resultant of the tractions on the hole boundary is a single force acting along the line  $\theta = 0$ , is obtained in finite terms.

## 20. On stress concentration of an isotropic elastic disc of some boundaries rotating steadily in its plane.

D. N. MITRA, Kharagpur.

Stresses and displacements of the above disc are found in this paper by the function-theoretic method, in case of a cardioid and an inverse of an ellipse by the application of Muschelisvili's method.



21. Stress Distribution in a Thin Plate having Parabolic boundary due to a concentrated force at the focus.

GUNADHAR PARIA, Kharagpur.

The stresses in a thin plate of elastic material with a parabolic boundary, due to a concentrated force acting at the focus parallel to the axis of the parabola, have been found by the method of superposition. A method of determining the stresses *directly in terms of Fourier integrals* without the help of the stress function or the stress potential is found very helpful. The displacements are determined by the use of complex variable. Numerical values of the edge stress have been calculated and these have been compared with the corresponding values for an infinite straight boundary. The former values are seen to be much higher than the latter ones within a certain range.

22. On the Effect of a Rigid spherical inclusion in a semi-Infinite Elastic Solid under stresses produced by a Couple on the plane boundary.

SISIR CHANDRA DAS, Chandernagore.

The use of dipolar coordinates has recently been started by Sternberg and Sadowsky (J. Appl. Mech. Vol. 19, (1952), pp. 19-27) and by the author (Bull. Cal. Math. Soc., Vol. 45 (1953), pp. 89-93) in solving three dimensional problems of elasticity. The above mentioned co-ordinates have been employed in this paper to find the concentrations of stresses due to a perfectly rigid spherical inclusion situated near the plane face of a semi-infinite elastic solid under the stresses produced by a couple acting at the plane surface with its axis perpendicular to it

23. Singularly Loaded Rectilinear Plates.

B. D. AGARWALA, Kharagpur.

This is a study of the behaviour of thin isotropic simply supported rectilinear plates under isolated couples at angular points or points on the axes of symmetry of the plates. The results for the deflection and the shearing forces are obtained in terms of elliptic functions and their numerical values tabulated. The cases dealt with are : 1. A Square; 2. An Equilateral triangle; 3. A right angled isosceles triangle; 4. A  $120^\circ - 30^\circ - 30^\circ$  triangle; 5. A  $90^\circ - 60^\circ - 30^\circ$  triangle.

24. A Rectangular plate bent into a Right Cylindrical Surface.

MD. MAHFOOZ ALI SIDDIQUE, Hyderabad.

The above problem is solved by introducing a constant parameter  $k$  into the expressions for displacement neglecting however its squares and higher powers and using the stress-strain relations.

$$T_{xx} = \lambda \Delta + 2\mu \epsilon_{xx}, T_{xy} = \mu \epsilon_{xy} \text{ etc.}$$

Displacements and bending couples being calculated it has been shown that apart from the bending couples, longitudinal and tangential forces have to be introduced to maintain the plate in this form.

25. Flexure of Composite beam of Rectangular Cross-sections with a common side.

J. RAMAKANTH, Hyderabad.

Using non-linear stress-strain relations of the type,

$$T_{xx} = \lambda \Delta (1 - \Delta) + 2\mu [1 - (\lambda + \mu) \Delta] \varepsilon_{xx} - 4\mu [\varepsilon^2_{xx} + \varepsilon^2_{xy} + \varepsilon^2_{xx}],$$

$$T_{xy} = 2\mu [1 - (\lambda + \mu) \Delta] \varepsilon_{xy} - 4\mu [\varepsilon_{xx} \varepsilon_{xy} + \varepsilon_{yy} \varepsilon_{zy} + \varepsilon_{yz} \varepsilon_{zx}] \text{ etc.,}$$

the above problem is solved on consideration of finite deformation.

26. Separable Solution of plane Compressible flow in heat conducting gas

G. BANDYOPADHYAY, Kharagpur.

The equations of plane flow of a compressible gas has been investigated with heat conduction taken into account. This adds one differential equation in the set instead of the isentropic (algebraic) relation between pressure and density. A certain type of solution (analogous to the homologous motion of stars, well known in astrophysics) has been investigated and the conclusion arrived at is that any constant velocity of gas front is possible under suitable conditions. This may be compared with similar investigation of Copson and McVitte (MNRAS, Vol. 110) which showed that ultimate attainment of escape velocity could by no means be avoided, which was contradictory to observation. This paper resolves this contraction.

27. Boundary Layer for a Parabolic Cylinder.

Y. D. WADHWA, Kharagpur.

The thickness of the boundary layer for the flow of a liquid past a parabolic cylinder is discussed with the help of "Synthetic Method" due to Seth. It is found that this thickness is now of the order of  $R^{-1}$ , as found by Dean, but is of the order of  $R^{-k/(2+\lambda)}$  [ $0 < k < 1$ ,  $0 < \lambda < 1$ ] which is greater than  $R^{-1}$ . For  $R \geq 10^4$  the thickness is at least of the order of  $R^{-1/4}$ .

28. On the instability of a single row of vortices of equal strengths alternatively positive and negative.

KAMINI KUMAR DE, Calcutta.

A single row of vortices of equal numerical strengths  $k$ , alternatively positive and negative and extending to infinity in both directions is known to induce no velocity in itself. By giving the system a slight displacement the change in the complex velocity has been obtained. Finally, it has been shown in this paper that at any time  $t$ , the disturbance is of the form  $Ae^{mt} + Be^{-mt}$  where  $m$  is real and the conclusion is that the system is unstable.

29. Boundary Layer effects in Non-Newtonian Fluids.

M. K. JAIN, Kharagpur.

Using second order terms in stress-strain velocity tensor relations the hydrodynamical equations governing the flow of non-Newtonian fluids have been set up



and solved by employing a synthetic method due to B. R. Seth. The uniform motion of a sphere and a circular cylinder are discussed in detail. The solutions show that for large Reynolds numbers a boundary layer is formed in the immediate vicinity of the boundary, the motion remaining irrotational elsewhere. The effect of cross-viscosity like that of viscosity is also confined to this layer. The drag co-efficients remain unaffected by cross-viscosity.

### 30. Axisymmetric Flow in perfect Fluid.

Motion of a spheroid along the axis of a rotating liquid

B. S. FADNIS, Kharagpur.

The problem considered is that of a spheroid moving along the axis of rotating liquid. The boundary conditions of a perfect fluid flow theory are insufficient to determine all the constants that occur in the solution. Exact solutions (in terms of spheroidal wave functions) are given corresponding to the condition of zero—slip between the surface of the solid and the liquid. The following limiting cases are obtained from (a) prolate and oblate spheroid, (b) prolate spheroid, (c) oblate spheroid, respectively.

1. Sphere moving uniformly along the axis of a rotating liquid.
  2. Pressure line of finite length moving along the axis of a rotating liquid.
  3. Circular disc moving along the axis of a rotating liquid such that the axis of the disc coincides with the axis of rotation.
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## SECTION OF STATISTICS

PRESIDENT : DR. V.G. PANSE, Ph.D. (Lond), F.N.I.

### *Abstracts*

1. Distribution of the range in samples from a discrete rectangular population.

A. R. KAMAT, Poona.

In this paper the distribution of the range in samples from a discrete rectangular distribution is found, sampling being done *without* replacement. Factorial moments and central moments of the range are derived and limiting forms of the moments and the distribution are discussed. This distribution is compared with the distribution of the range when sampling is done *with* replacement and also with the distribution of the range in samples from a *continuous* rectangular distribution. To test the hypothesis whether two given samples come from rectangular populations with the same spread, a statistic based on the difference of the two ranges is proposed and its distribution is derived.

2. A note on the distribution of the product of ranges in samples from rectangular population.

D. N. LAL, Patna.

An expression has been obtained for the distribution of the product of ranges from  $k$  independent samples of unequal sizes such that they do not differ by unity. The case where they differ by unity has been discussed for three samples only. No general form in this case seems to be available in the general case. A general expression has also been obtained for the  $r$ -th moment of the distribution.

3. On some characterization properties of normal distributions.

K. C. CHANDA, Bombay.

Let  $X_1, X_2, \dots, X_n$  be  $n$  mutually independent but not necessarily identical random variables with finite moments of some positive order  $\delta < 1$ . Then, it has been shown that if two linear functions  $Y_1 = \sum_{i=1}^n a_i X_i$  and  $Y_2 = \sum_{i=1}^n b_i X_i$  are independently distributed, each  $X_i$  with non-zero coefficient in each of the linear functions  $Y_1, Y_2$  has a normal distribution.

4. A method of determining a quantile from grouped data.

N. M. BHATT, Baroda.

The usual method of determining a quantile from grouped data, assumed to be free from errors of sampling, is by a linear interpolation in the cumulated frequency



table. This method assumes the distribution curve to be linear in the range of interpolation, which is not the case. Hence the method does not give good results in practice. Even if the method is modified by making a laborious higher degree inverse interpolation, there is not much improvement in the result. A new method, based on the assumption that the observed variate is a polynomial in the standard normal variate, is given in this paper and it is found to give very good results in practice.

#### 5. Wald's two moments problem.

S. S. SHRIKHANDE, Nagpur.

Let  $X$  be a non-negative random variable with two given moments  $M_r$  and  $M_s$  about zero of orders  $r$  and  $s$ ,  $r < s$ . The problem of finding the least upper bound  $b_d$  of  $P(x \geq d)$  was solved by Wald (Ann. Math. Stat. 1938). A new method of obtaining the same result is given in this paper. The method is of much wider application and has been used to obtain some new results.

#### 6. On the distribution of the ratio of classical $D^2$ -statistic based on $p$ and $q$ characters.

D. P. BANERJIE, Meerut.

Mahalanobis (1930) has introduced the idea of divergence of two populations as tests of significance cannot always answer all questions. Rao (1946) found the distribution of the ratio of  $D^2$  under some conditions. The test based on the ratio of  $D^2$  calculated on  $p$  and  $p+r$  characters is used to test whether the inclusion of  $r$  more characters to basic characters results in an increase in the divergence between the populations.  $D^2$  statistics may also be employed to measure the distance or the extent to which two sets of multiple measurement differ. The exact distribution of the ratio of two different  $D^2$  statistics has been found and the method applied to find the ratio of two different multiple correlation coefficients from large samples. The result is extended to analysis of variances and to test the discriminant function.

#### 7. A note on a form of the Weak Law of Large Numbers associated with several variables.

D. N. LAL, Patna.

A form of Tchebycheff's inequality for more than one variable was obtained earlier and here an attempt is made to obtain the corresponding form of the Law of Large Numbers.

#### 8. Biased steps along a line.

A. K. CHAUDHURI, Kharagpur.

It is known that random walk problems serve good models for diffusion processes and Brownian motion. The continuous linear diffusion process has been supposed

to be made up of a large number of small discrete steps taken at random which ultimately tend to zero. The probability of taking steps towards the right and left are supposed according to Feller to be  $p = \frac{1}{2} + \frac{C}{2D} \Delta x$  and  $q = \frac{1}{2} - \frac{C}{2D} \Delta x$  respectively where  $D$  is the diffusion co-efficient and  $C$  is the drift. By applying limiting process to the Binomial distribution of steps in the negative and positive directions—it has been found that the displacement of a particle in time  $t$  obeys the normal distribution law

$$\frac{1}{\sqrt{2\pi \cdot 2Dt}} e^{-\frac{(x-2Ct)^2}{4Dt}}$$

which agrees with Feller's result deduced on heuristic arguments.

## 9. A system of orthogonal polynomials.

J. DUTTA AND D. N. LAL, Patna.

In this note a system of orthogonal polynomials associated with Pearson Type VII curve is studied. It has been shown that they satisfy a number of known properties of the well known orthogonal polynomials, namely, the differential equation, recurrence relation etc. A list of only first ten polynomials has been reported, others can be written down quite easily.

## 10. Study of the effect of unequal error variances on the pooled $F$ test.

P. K. BHATTACHARYYA, Calcutta.

The effect of inequality in the error variances on the pooled  $F$ -test has been studied by Quensel, David and Johnson, Box and others. But this study has been limited to consideration of the level of significance only and that too by approximate formulae. In the present paper a detailed study of the level of significance and the power has been made when the  $F$  test, defined as the ratio of one mean square with population error variance  $\sigma_1^2$  and an independent pooled mean square of two error mean squares with population error variances  $\sigma_1^2$  and  $\sigma_2^2$ , is referred to ordinary  $F$  tables. The normality assumption is, of course, involved.

The necessary distributions for the null and the non-null cases have been worked out and the exact level of significance and power of the test have been evaluated using these distributions. It is found that the error of first kind is always controlled when  $\theta = \frac{\sigma_1^2}{\sigma_2^2} < 1$ , but for  $\theta > 1$ , it is less than a value  $\alpha'$  which is greater than the assumed level of significance. For any particular value of  $\theta$ , the exact level of significance varies with the treatment d.f. and error d.f., but these variations are not very large. For  $\theta > 1$ , the power of the test is greater than that of the test when  $\theta = 1$ . For  $\theta < 1$  the power of the test does not compare favourably with even that of the  $F$ -test using a single valid error mean square; for moderate deviations, however, the test is not as bad. Thus it would seem that for moderate deviations in  $\theta$  on both sides of unity, say  $0.8 < \theta < 1.2$ , the test can be usefully applied.



## 11. On the standard error of the coefficient of belonging.

A. M. GUN, Calcutta.

It is often desired, especially in psychometry, to group a large set of variables into a few subsets, each containing variables of a similar nature (in the sense that the variables in a subset are associated highly among themselves—higher than with other variables of the whole set). To do this Holzinger and Harman suggested the use of the “coefficient of belonging” ( $B$ ). However, this coefficient will not be of much practical help unless its sampling distribution or, at least, its standard error is known.

In the present paper, the variables to be grouped have been assumed to be normally distributed and the sample size sufficiently large. Proceeding from these assumptions, formulae for the variances and covariances of sample correlations have been obtained and these finally used to get an approximate expression for the standard error of  $B$ .

## 12. The product-moment correlation and the reliability coefficient.

A. K. GAYEN, Kharagpur.

In this paper a comparative study has been made of the distributions of product-moment correlation, as defined by the ratio of product-moment and the geometric mean of the variances of the two variables, and the reliability coefficient, being the ratio of product-moment and the arithmetic mean of the two variances. There may not be much difference between the values of the product-moment correlation and the reliability coefficient in a sample. For as we know, when the population variances of the two variables are equal the maximum likelihood estimate of the parent correlation is given by the above formula of reliability coefficient. The expression is frequently used by psychologists in order to have a measure of consistency of a test by the test-retest and the alternative equivalent forms methods. As the distribution of reliability coefficient is not known, and the derivation of it appears to be difficult, investigations have been made here to see how far the frequency function of the product-moment correlation can be used for the purpose of its test of significance.

## 13. On a characterisation of the stable law with finite expectation.

R. G. LAHA, Calcutta.

The following theorem has been proved :—

Let  $x$ ,  $\xi$  and  $\eta$  be three chance variables each having a finite expectation where  $x$  is distributed independently of  $\xi$  and  $\eta$  but the joint distribution of  $\xi$  and  $\eta$  is of such a nature that the regression of  $\xi$  on  $\eta$  is linear. Then the necessary and sufficient condition for the regression of  $Y = bx + \eta$  on  $X = ax + \xi$  to be linear for all  $a$  contained in a closed interval  $(a_1, a_2)$  is that both  $x$  and  $\xi$  should belong to a family of stable law with finite expectation.

## 14. Estimation of linear structural parameters.

M. N. GHOSH, Calcutta.

The problem of estimating linear structural parameters when both variables are in error has been considered by Wald, Neyman, Scott and Bartlett, Nair and Banerjee

and others. It has been shown by Neyman and Scott that when the common part of the observables is a random variate, a consistent estimate exists only when the random variables representing error are of a very special nature. In this paper a more general type of linear structural relation between three variables is considered,

$$x = a\xi + u$$

$$y = b\xi + v$$

$$z = \xi + w$$

When  $\xi$ ,  $u$ ,  $v$ ,  $w$  are independent random variables and  $a$ ,  $b$  are the parameters of the structural relation which are to be estimated from the sample. The method consists in ordering  $x$  and  $y$  values according to the corresponding  $z$  values and using an analogue of Wald's method of estimation for  $a$  and  $b$ . It has been shown that the above method leads to consistent estimates of the parameters.

#### 15. On statistics independent of a complete sufficient statistic.

D. BASU, Calcutta.

If  $\{P_\theta\}$ ,  $\theta \in \Omega$ , be a family of probability measures on an abstract sample space  $X$  and  $T$  be a sufficient statistic, then for a statistic  $T_1$  to be stochastically independent of  $T$  it is necessary that the probability distribution of  $T_1$  is independent of  $\theta$ . The condition is also sufficient if  $T$  is a boundedly complete sufficient statistic. Certain well known results in distribution theory are immediate corollaries of the above results. Interesting characterizations (believed to be new) of the Normal and Gamma distributions are deduced. For instance, it is proved that if  $x_1, x_2, \dots, x_n$  are independent random variables whose joint distribution involves an unknown location parameter  $\theta$  and if further  $\sum b_i x_i$  is a boundedly complete sufficient statistic for  $\theta$  then, for each  $i$ ,  $b_i > 0$  and  $x_i$  is distributed as a normal variable with mean  $\theta$  and variance  $1/b_i$ .

#### 16. Some estimators in sampling with varying probabilities without replacement.

DES RAJ, Calcutta.

In order to estimate the total (or mean) of a finite population when the units are selected with varying probabilities without replacement, the estimators so far presented, namely those given by Horvitz and Thompson and Yates and Grundy, have the disadvantage that an unbiased estimate of the error variance may become negative. This paper gives a set of unbiased estimators of the population total (or mean) for which an unbiased estimator of the error variance cannot be negative. The results obtained are extended to multi-stage designs. Several other estimators are also considered.

#### 17. Comparison of expected lengths of confidence intervals for mean for two methods of sampling from normal population.

I. M. CHAKRAVARTI, Calcutta.

Two methods of sampling, *viz.* (i) selecting  $N$  units at random, (ii) selecting  $k$  groups of  $n$  units each so that  $N = nk$ , from normal population are compared from the point of view of setting confidence interval with different confidence coefficients.



## 18. The intra-class correlation from a new angle.

M. V. JAMBUNATHAN, Mysore.

The concept of intra-class correlation has been receiving increased attention in recent years on account of its important role in the theory of sampling. In the case of cluster sampling the choice of the sampling plan and the size of the sample for a given cost are largely influenced by the sign and magnitude of the intra-class correlation. Certain discrepancies in the classical interpretation of the analysis of variance as applied to intra-class correlation led Irwin (1946) to suggest some modifications. But even these modifications fail to explain the exact nature of the intra-class correlation. The author of the present paper has made a close study of the subject and has posed a satisfactory model capable of effectively explaining all the connected results. The present paper carries the study a step further and introduces the concept of the configurational sample which generates the appropriate set of stochastic variates which furnish an insight into the mechanism of the mathematical model from which the usual results regarding the variance of the sample mean follow as simple corollaries.

## 19. Generalisation of a theorem on optimum allocation.

M. V. JAMBUNATHAN, Mysore.

In an earlier paper (Proc. 41st Ind. Sci. Cong.) the author has proved a theorem on the apportionment of the total cost between the first stage and the second stage operations when two-stage sampling is adopted. The present paper generalizes the theorem to three-stage sampling, under analogous conditions. The following theorem is proved .:

Under optimum allocation in three-stage sampling, the shares of the total cost towards the first stage, second stage and third stage operations are proportional to the geometric means between the corresponding unit cost and unit variances

## 20. Difference theorems for the construction of Group Divisible Designs.

P. M. ROY, Calcutta.

In this paper the following theorem which generalizes theorems 2 and 3 of Bose, Shrikhande and Bhattacharya (Annals of Math. Stat., 1953) has been proved :

*Theorem :* Let  $M$  be a modul containing  $v$  elements  $0, 1, 2, \dots, v-1$  and to each element  $e$  of the modul let there correspond exactly  $\mu$  varieties,  $e_l$ ,  $l=1, 2, 3, \dots, \mu$ . Varieties  $e_l$ ,  $e=0, 1, \dots, v-1$  will be taken as belonging to the  $l$ -th class. Let it be possible to divide the  $\mu v$  varieties into  $m-q$  groups of  $n-\pi$  varieties each such that by adding any element  $\varepsilon$  of the modul  $M$  to each of the elements of a group we get back the same group when  $\pi \neq 0$  and any one of the  $m-q$  groups (mod  $v$ ) when  $\pi=0$ . To the  $i$ -th group let us adjoin  $\pi$  invariant elements  $I_{ig}$ ,  $g=1, 2, \dots, \pi$  each of which will represent a new variety. To the  $m-q$  groups of  $n$  varieties thus obtained let us adjoin the following  $q$  groups of invariant elements representing  $nq$  new varieties ( $\alpha_{i1}, \alpha_{i2}, \dots, \alpha_{in}$ ),  $i=1, 2, \dots, q$ . Thus in all we get  $mn$  varieties. Now suppose it is possible to find a set of  $t$  blocks of size  $k$  each (varieties contained in a block being all different) satisfying the following conditions :

A. Among the  $kt$  varieties occurring in the  $t$  blocks

(i) exactly  $r$  varieties corresponding to the non-invariant elements belong to each of the  $\mu$  classes,

(ii) each of the invariant elements occurs exactly  $\frac{r}{v}$  times in such a way that (a) each of the  $I$ 's and  $\alpha$ 's occurs with  $\lambda_1$  non-invariant elements of every class of its own group and  $\lambda_2$  non-invariant elements of every class of any other group, and (b) each of the  $I$ 's and  $\alpha$ 's occurs  $\frac{\lambda_1}{v}$  times with each of the invariant elements of its own group and  $\frac{\lambda_2}{v}$  times with each of the invariant elements of any other group.

*B.* Among the differences arising out of the  $t$  blocks, each of the differences ('pure' as well as 'mixed') which can arise out of the  $m-q$  groups of non-invariant elements repeats exactly  $\lambda_1$  times and any other difference repeats exactly  $\lambda_2$  times.

Then by developing the  $t$  initial blocks (mod  $v$ ) we get a *GD* design.

## 21. On some simple properties of semi-regular Group Divisible Designs.

P. M. Roy, Calcutta.

In this paper the following theorems on the properties of semi-regular *GD* designs have been proved :

*Theorem I :* If a *GD* design has the property that every block contains  $c$  treatments from every group, then the design is a semi-regular one. (This is the converse of the Theorem 4 of Bose and Connor, *Annals of Math. Stat.*, 1952).

*Theorem II :* If a semi-regular *GD* design with  $v=nm$ ,  $b$ ,  $r$ ,  $k=cm$ ,  $n_1=n-1$ ,  $n_2=n(m-1)$ ,  $\lambda_1$ ,  $\lambda_2$  is  $\lambda$ -times linked one, then by omitting a block and the varieties contained in it we get a regular *GD* design with  $v^*=(n-c)m$ ,  $b^*=b-1$ ,  $r^*=r$ ,  $k^*=k-\lambda$ ,  $n_1^*=n-c-1$ ,  $n_2^*=(n-c)(m-1)$ ,  $\lambda_1^*=\lambda_1$ ,  $\lambda_2^*=\lambda_2$ .

*Theorem III :* Corresponding to every semi-regular *GD* design with  $v=nm$ ,  $b$ ,  $r$ ,  $k=cm$ ,  $n_1=n-1$ ,  $n_2=n(m-1)$ ,  $\lambda_1$ ,  $\lambda_2$  there are  $m-2$  more semi-regular *GD* design with

$$v^*=n(m-l), b^*=b, r^*=r, k^*=c(m-l),$$

$$n_1=n-1, n_2=n(m-l-1), \lambda_1^*=\lambda_1, \lambda_2^*=\lambda_2 \quad (l=1, 2, \dots, m-2),$$

which can be obtained simply by omitting the  $lm$  varieties occurring in any  $l$  of the  $m$  groups. (Implications of this theorem have already been noted by Bose, Shrikhande and Bhattacharya, *Annals of Math. Stat.*, 1953).

## 22. Some properties of a simple stochastic model with time-trending coefficients.

D. V. RAJALAKSHMAN AND M. MADHUSUDANA RAO, Madras.

Though the linear autoregressive schemes have been introduced to provide suitable models for the study of time series, it is often felt that, in practical application, these are not flexible enough to represent adequately the observed time-series. It is considered that these schemes will be more appropriate if the constant coefficients are



replaced by those that depend on time. To study the effects of time-trending coefficients on the structure of these schemes, some properties of the simplest model in discrete time given by  $x(t) + a(t)x(t-1) = \varepsilon(t)$  where  $\varepsilon$ 's are random orthogonal disturbances, are discussed in this paper. Besides giving a formal solution of the scheme, the properties of its correlogram are studied. It is also shown that the variates

$S_n = \sum_{r=1}^n x(t-r)$  for any fixed integer  $t$ , tend to normality as  $n$  tends to infinity in the

standard measure under certain conditions. The correlogram of this scheme  $S_n$  is obtained and compared with the correlogram of the original series. Some applications of this and higher order schemes to practical situations are also discussed.

### 23. Cycle of rainfall in some districts of U.P.

A. P. BHATTACHARYYA, Roorkee.

In this paper, an attempt has been made to trace the existence of a cycle, if any, of annual rainfall on a district-wise basis for three districts of U.P., namely, Bareilly, Agra and Fyzabad, based on Kendall's methods of studying Time Series. The series of rainfall figures consisted of 50 years for each district.

The cycle of variations for the three districts revealed a wide variation in the distribution and the type of the cycle. The mean periods worked out to 4.8, 6.26 and 4.24 years for the districts of Bareilly, Agra and Fyzabad respectively.

### 24. Spells of abnormally hot and cold days during the hot weather period April-May and winter December-January respectively at Poona.

T. R. SRINIVASAN, Poona.

The observed frequencies of spells of different length of abnormally hot and cold days (in the hot weather period and winter respectively) are shown to be in agreement with the successive terms of the logarithmic series  $\sum \frac{\alpha x^r}{r}$  where  $\alpha$  and  $x$  are constants to be determined from the data,  $r$  the length of run. The quantity  $x$  can be used in predicting 'a further abnormal day'.

### 25. Salinity pattern in the river Hooghly.

M. K. GANGULI AND H. RAMMURTHY, Poona.

Study of salinity in the river Hooghly and the possibility of reducing it at the off-ake of the Calcutta domestic water supplies are of vital importance. Attempts are being made to work out the problem from the model studies. To start with in all such experimentation proving the model is a necessary and fundamental step. Once the model reproduces the original problem faithfully, the remedial measure suggested from the model is expected to be reasonably successful in the prototype. As an aid to the initial proving of the salinity characteristics, therefore, investigation of the presence of salinity pattern in the prototype data has been made,

The six years' (1940-45) salinity records for the dry season available at the three gauging stations *viz.*, Garden Reach, Cossipore, and Mulajore when analysed have shown significant consistency in the proportional salinity variations from station to station and month to month for all the years. The paper also gives in this connection an iterative solution of the normal equations arising from the minimization of the error sum of squares when the effects of the various factors are not additive but are better represented multiplicatively.

## 26. Estimation of soil heterogeneity in jute trials.

S. N. SEN, Barrackpore.

In the jute trials, the index of soil heterogeneity can be measured from the *b* coefficient of Smith's empirical relationship connecting plot size and standard error per plot. The value of '*b*' is higher in case of blocks with smaller number of plots indicating that soil heterogeneity is less for smaller block size. The relative reduction in variability for relative increase of plot size is similar throughout the range observed. The regression equations obtained from the jute trials are found to be

$$\text{i) } \frac{4 \text{ plots per block}}{\log (se)=1.41-0.446 \log x}$$

$$\text{ii) } \frac{12 \text{ plots per block}}{\log (se)=1.43-0.426 \log x}$$

where *se* = s. e. per plot and

*x* = plot size in acre.

## 27. Quality control by gauging.

J. ROY, Calcutta.

Assuming normality of the underlying distribution of the quality characteristic of a manufactured product, and by considering for samples of a fixed size and joint distribution of the proportion of articles having quality characteristic below a certain pre-assigned level, and also the proportion of articles having quality characteristic above a certain other pre-assigned level, it has been possible to devise a single control chart to detect variations either in the mean quality level, or in the process variability or in both. The advantages of the method are three-fold : 1. A single chart instead of the usual two, the mean and the range charts, is called for; 2. by the method of gauging fairly large samples can be handled and 3. the arithmetical procedures are rather simple.

## 28. A Study on the prediction of success in engineering courses.

U. K. SEN, Kharagpur.

In this study an attempt has been made to obtain some prediction equation for future success of candidates following up courses in different branches of engineering. Data considered for prediction are (1) School Final Examinations Record, (2) Intermediate or Bachelor of Science Examination result and (3) Score on interview. A



linear function obtained appears to be a satisfactory predictor. A single year's record may not however be considered as sufficient for the ideal prediction equation. The study should be followed up to ascertain the stability of a derived equation, and also to investigate the contributions of other factors to the criterion variable.

## 29. Statistics of library utilization.

N. T. MATHEW, Delhi.

This paper gives a detailed analysis of the number of books borrowed during 1953 from the Ministry of Defence Library. It is shown that the percentage of books taken out varies widely between different subjects and different groups of borrowers. By the use of punched card equipment it has been possible to prepare lists of "popular books" which may serve as a guide to the pattern of demand from the borrowing population.

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## SECTION OF PHYSICS

### *Abstracts*

#### Ionospherics

##### 1. Effects of sunrise in different Ionospheric regions.

B. CHATTERJEE, Kharagpur.

The paper describes the results of investigations carried out for finding out the effects of sunrise on different ionospheric layers. It is observed that for the *F* layer at Calcutta (a low latitude station) the 'sunrise effect' always takes place after the *F* region sunrise but before the ground sunrise. The delay in time from the *F* region sunrise varies with the season. Similar results are observed also for the *E* region. But in this case, a sharp ionization density gradient is formed at the bottom of the *E* layer which behaves as a sporadic *E*. The normal ionization distribution is regained with the ground sunrise. For the *D* layer, the ionization commences always after ground sunrise and gradually builds up with the approach of the noon.

##### 2. Determination of the true vertical velocity of the *E*-layer.

B. RAMACHANDRA RAO AND B. C. NARASINGA RAO, Waltair.

The variation of the equivalent path of the radio waves due to critical frequency changes of the reflecting layer has complicated the calculations of the layer velocities by previous workers using the periodic fading of the continuous wave radio signals. A simple method is suggested to separate out the two effects from the mixed type of periodic fading. Simultaneous fading records on the two transmissions from A.I.R. transmitting stations Madras A and Madras B are taken and the number of periods per hour is calculated from each record. The number of periods produced by the critical frequency change are subtracted from the total number observed, to obtain those caused due to layer movement. The fact that the ratio of the periods due to layer lifting on the two records should be a constant, guides us in choosing the correct value of the critical frequency change during the period of observation. The layer lifting velocities then obtained during the morning hours is found to be about 1.8 Km/hr. a value which is more lower than that given by previous investigators.

##### 3. Investigation of vertical movements of the $F_2$ Region of the ionosphere.

B. RAMACHANDRA RAO AND N. V. GURUNATHA SARMA, Waltair.

Periodic fading patterns were recorded photographically with Madras B signals of frequency 4920 Kc/s received at Waltair (distance 640 Km) during the evening



hours of October 1953. The chief purpose in selecting the frequency, the time of the day and the distance of the transmitting station was to receive only the singly reflected waves from both  $E$  and  $F_2$  layers. It has been shown that, in such cases, the assumption made by the previous workers that both the layers were moving with the same velocity was not necessary in interpreting the observed periodic fading and the expression for the fading periodicity has been modified by taking the vertical velocities of the two layers to be different. Using this expression the vertical velocity of the  $F_2$ -layer can be determined using the previously known value of the  $E$ -layer velocity obtained from medium wave records taken separately during the same time. The vertical velocity of the  $F_2$ -layer as computed from this view do not show as much variation as that obtained from previous workers' stand point and also it is found to be definitely greater than the  $E$ -layer velocity.

#### 4. Some Studies in Random Fading of Radic Signals.

(MISS) G. V. SUBHADRAMMA, Banaras.

Some studies of the experimental records of random fading taken at Banaras on short-wave bands for oblique-incidence continuous transmissions from several distant broadcasting stations situated at different distances upto 2160 Kms. are given in the paper. The experimental arrangements have been described and statistical analyses of the fading observations have been made with reference to (i) the time-variations in signal amplitude and to (ii) the variations in the change of amplitude over a small time-interval. For the time-variations of the amplitudes, the Rice distribution formula has been applied and the values of the ratio of the steady reflected component ( $B$ ) to the r.m.s. value of scattered component ( $R$ ) from the ionosphere have been determined for the various experimental records. In all the fading observations, the amplitude distribution was not of the Rayleigh type, as  $b$  which is equal to  $B/\sqrt{2}R$  was always found to be greater than unity. Following a procedure worked out by Fürth and Macdonald and first applied by Ratcliffe to the signal amplitude changes over a short time interval, the r.m.s. line-of-sight velocity of the ionospheric irregularities has been evaluated. The value has been found to be of the same order of magnitude as that found by Mitra and also by McNicol. Theoretical considerations in respect of the statistical analysis of the experimental records have also been indicated in the paper.

#### 5. Determination of the $F$ -region collisional frequency over Calcutta.

(MISS) MRINMAYEE GHOSH, Patna.

In the present paper, the collisional frequency of the  $F$ -region over Calcutta has been determined for different hours of the day and night (0600 to 2000 hours) using a manual type ionospheric recorder. It has been found that though the average value of the collisional frequency is of the order of  $10^3/\text{sec.}$ , its actual value varies from hour to hour, extending from the order of  $10^2/\text{sec.}$  to the order of  $5 \times 10^3/\text{sec.}$  The maximum value occurs near about the noon and the minimum value near about midnight. A probable explanation of this type of variation has been sought in the diurnal variation of temperature in the upper atmosphere.

## Optics and Spectroscopy

### 6. Near ultra violet Absorption spectrum of *P*-dichlorobenzene.

B. D. JOSHI, Banaras.

The absorption spectrum of *p*-dichlorobenzene vapour in the region 2900–2450 Å, was studied with the Hilger  $E_1$  quartz spectrograph. The band at  $35755\text{ cm}^{-1}$  is assigned as the 0,0 band of the allowed electronic transition  $A_{1g}-B_{3u}$ . The ground state frequencies observed are 248, 333 and  $413\text{ cm}^{-1}$ . The upper state frequencies are 329, 528, 720, 1058, 1463 and  $3087\text{ cm}^{-1}$ . The prominent bands are mostly combinations of the upper state vibrations and only the vibrations 720 and  $1058\text{ cm}^{-1}$  show progressions. Each of the prominent bands is accompanied by a small group of bands on the longer wave-length side at separations of 28,  $2 \times 28$ , 84,  $28+84$  and sometimes of  $2 \times 84$ .

### 7. The Near Ultraviolet Absorption Spectrum of 1,3,5-Trifluorobenzene Vapour.

M. L. N. SASTRI, New Delhi.

The absorption spectrum of 1,3,5-trifluorobenzene vapour was photographed in a 3m grating spectrograph. The spectrum was studied in dependence of the vapour pressure. Discrete absorption was obtained in the region 2700 to 2300 Å. The appearance of groups of bands in the spectrum was discussed. An analysis was attempted assuming that the spectrum has its origin in a "forbidden transition". The symmetry of the molecule is  $D_{3h}$  and the electronic transition is  $A'_1-A'_2$ . The vibration which destroys the  $D_{3h}$  symmetry and makes the forbidden transition "allowed" is of type  $\epsilon'$ , probably of value  $503\text{ cm}^{-1}$ . Totally symmetric vibrations were observed to occur in progressions and combinations. The calculated position of the 0,0 band is  $38527\text{ cm}^{-1}$ .

To obtain the fluorescence spectrum, 1,3,5-trifluorobenzene was irradiated by light from Fe, Mn, Ni, Cd, Cu, Bi and Al sparks and the Hg arc, but in no case could any fluorescence be detected.

### 8. On the Emission Spectrum of Acetaldehyde.

I. ACHYUTA RAO AND V. RAMAKRISHNA RAO, Waltair.

An emission spectrum of acetaldehyde is taken using an Ozoniser type of discharge run at high vapour pressure. A voltage of 20,000 V is applied between the two electrodes. The discharge appears pale-green in colour and an exposure of 6 hrs. is given with a Selochrome plate on Fuess spectrograph. The spectrum contains the bands due to CO and  $N_2$  as impurities and two broad bands attributable to none of the impurity spectra are recorded one at 5154 Å.U. and other at 5662 Å.U. The latter one is stronger than the former. The bands are about 200 Å.U. in width and are at a separation of about  $1740\text{ cm}^{-1}$ . This frequency shift corresponds to the C=O valence vibration ( $1730\text{ cm}^{-1}$ ) in the ground state from the analysis of the near Ultraviolet absorption spectrum carried out by us. The corresponding values in Raman and Infrared spectra are 1724 and 1726/1758 respectively.



## 9. Further Studies of the Twilight Illumination.

M. W. CHIPLONKAR, P. V. KULKARNI AND D. V. BADVE, Poona.

Measurements of the absolute intensity of the zenith sky during twilight were carried out at Mt. Sinhagad (Height 4,400 ft. above Mean Sea Level) with a visual photometer using two monochromatic interference filters transmitting a very narrow spectral region around  $\lambda$  5577 Å and  $\lambda$  6300 Å during the months of April and May 1954. During this period perfectly clear moonless twilight conditions were obtained on 16 mornings and 10 evenings only. The results of these measurements are compared and discussed with those reported earlier <sup>1,2,3,4</sup>. As observed before, the intensity of the scattered light in the red is much smaller than that in the green during the civil twilight. The use of the monochromatic filters in the present measurement, however, has revealed a tendency of the intensity of the red line to exceed that of the green line when the Sun is  $-8^\circ$  to  $-9^\circ$  below the horizon. To verify this significant observation further measurements are in progress using a photomultiplier photometer. The total number of light quanta of  $\lambda$  5577 Å received from the zenith sky at the end of twilight is calculated from the present measurements.

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## 10. Studies on Fluorescence of Organic Compounds.

S. K. K. JATKAR AND B. N. MATTOO, Poona.

Fluorescence of coumarins and flavones have been studied in this paper using the Hilger-Spekhar Fluorimeter. The difference between the characteristic absorption frequencies and the emission frequencies has been found to correspond to the fundamental and harmonics of the vibrational frequencies of groups such as C-O, CH, NOH present in these compounds.

## 11. Two simple methods for studying elliptically polarized light with Babinet's Compensator (Jamin type).

L. V. DESHPANDE, Visnagar.

The preliminary adjustments of the Compensator and the analyser with plane polarized white light are done as usual. But the Compensator is not reduced to a quarter-wave plate and rotation of only one piece is read accurately.

The elliptical vibration incident is considered as a resultant of two component linear vibrations along the fast and slow axes (taken as  $X$  and  $Y$  axes respectively) of the fixed wedge of the Compensator, and having the amplitude ratio  $\tan \delta$  and phase difference  $\beta$  between them. Measurements on the zero-phase band give  $\delta$  and

$\beta$  directly and then the transformation formulas— $\tan 2\phi = \tan 2\delta \cos \beta$  and  $\tan^2\theta = \tan(\delta + \phi) \cdot \tan(\delta - \phi)$ —give the orientation and the ratio of the principal axes of the ellipse.

The mode of vibration and the approximate orientation of the axes can be read from a Chart, which can be prepared for every Compensator, giving these characteristics of the elliptical vibration for different values of  $\delta$  and  $\beta$ .

In the first method the Compensator is kept fixed and the analyser alone is turned through an angle  $\gamma$  till the zero-phase band becomes the darkest without being displaced. Then  $\delta = 45 + \gamma$ . Measuring the shift of the zero-phase band  $\beta$  is determined in the usual way.

In the second method the analyser is attached rigidly to the Compensator, its axis being at  $135^\circ$  with the  $X$  axis. Then the piece—the Compensator and the analyser—is turned as a whole through an angle  $\eta$  till the zero-phase band, which will now be displaced, becomes the darkest. The phase difference  $\beta$ , corresponding to this position of the band, is determined as usual. The ratio and the orientation of the axes of ellipse with respect to the original position of the  $X-Y$  axes are given by  $\phi = 45^\circ + \eta$  and  $R = \tan \frac{\beta}{2}$ . For the mode of vibration the chart is read.

All the characteristics of the same elliptical vibration were determined by the three methods and the results were found to be in good agreement.

The first method can be directly used in determining the optical constants of metals.

## 12. The Absorption Spectrum of Benzoquinone

RAMA SHANKAR SINGH, Banaras

The absorption spectrum of benzoquinone in the vapour state has been investigated in the visible and the ultra-violet regions. A number of new bands in the ultra-violet (2200–3200Å) has been obtained in addition to those already recorded in literature. In addition, a new extended set of bands presumably belonging to another system has been measured in the visible region between 4100 and 5060Å. A discussion of these bands in terms of the known treatment for the benzene molecule is given.

## 13. Rotational temperature lag in CH(4315) and CH(3900) bands in a Flame

B. S. PATIL, Bombay AND N. R. TAWDE, Dharwar

Measurements of rotational temperatures of the two CH bands at  $\lambda 4315$  and at  $\lambda 3900$  have been made by resolving the bands and using the line intensity graph method. The bands were excited in a flame source maintained under uniform conditions. The bands gave values of temperature differing by about  $1700^\circ$ . The cause of this large lag in CH 3900 band has been discussed in the light of the mechanism of excitation in the inner cone and in terms of the energy of the electronic levels involved in the emission of the two systems. The nature of excitation, whether thermal or chemiluminiscent has also been discussed.

## 14. Influence of Oxygen and Air on the Intensity Distribution among the Bands of $N_2$ second Positive System

K. S. KORGONKAR, Bombay AND N. R. TAWDE, Dharwar

Relative intensity distribution among the bands of  $N_2$ , 2(P) system excited in a low pressure a.c. discharge, has been studied in pure nitrogen, in  $N_2-O_2$  mixtures



in four different proportions *viz.*, 95 : 5, 80 : 20, 50 : 50 and 5 : 95 and also in air. It is found that in  $N_2-O_2$  mixtures as well as in air, bands belonging to progressions with  $v'=0$  and 3, show enhancements in relation to other bands. The effect in the first progression is more pronounced than in the latter. Assuming Maxwell-Boltzmann distribution of vibrational energy, 'effective vibrational temperatures' have been obtained in each of the six cases, based only on the three lowest levels of  $N_2O^3\pi$  state *viz.*,  $v'=0, 1$  and 2, the data for higher levels being incomplete. The general order of these temperatures is much in excess of the expected translational temperatures in a discharge. However, a drop of the order of 2000 °K is found to occur, when oxygen is added to pure nitrogen. An attempt has been made to interpret the observed effects in terms of the energy transfers involving the molecules of nitrogen and oxygen.

### 15. Anomalous temperature of TiO bands in carbon arc

P. V. CHANDRATREYA, Bombay AND N. R. TAWDE, Dharwar

According to Coheur and Coheur, a single effective temperature is obtainable from radiations of a given molecule, in spite of its excitation under varied temperature conditions and sources. This point was, however, not confirmable from the observations of Tawde and Hussain on the same bands. All these temperature estimates generally fall within the range of temperatures existent in carbon arc. While investigating the transition probabilities of some astral molecules, temperatures have been worked out from vibrational intensity data in which the bands of TiO molecules gave, however, an abnormally low value of 1730° K in carbon arc in spite of very high temperatures known to be existing in this source. The value has been discussed in the light of discharge mechanism and in the light of known temperature data on this molecule from other experiments and justified on the basis of the concept of "optimum temperature" of molecular radicals in different sources and under different conditions.

### 16. A case for the fixation of internuclear separation ( $\Delta r$ ) in $\sum_x^2 \sum^2$ levels of LaO from intensity characteristics.

P. V. CHANDRATREYA, Bombay AND N. R. TAWDE, Dharwar.

The rotational structure analysis of the bands of  $\sum^2 - x\sum^2$  system of LaO being not available, the estimate of the theoretical transition probabilities in this system cannot be made in the absence of the knowledge of  $r'_e, r''_e$  and hence of ( $\Delta r$ ). Such data are of considerable significance in astrophysics. By investigating the intensity distribution in band systems of analogous oxides, AlO, TiO, BO and in this system of LaO, a connecting link has been found which enabled us to fix with good approximation the  $r'_e, r''_e$  and hence ( $\Delta r$ ) value in the electronic levels of the yellow system of LaO. The limitations of these values have been discussed.

### 17. Swan Bands in Rare Gases: Part I-Some peculiar features of the Development.

V. RAJESWARI AND N. R. TAWDE, Dharwar.

Quantitative intensity measurements in  $O_2$  (Swan) system have been extended to cases where the bands are produced in He, Kr and Xe at different pressures, ranging

from 1 mm to 30 mm. *Hg*. These results, coupled with the earlier quantitative study on *Ar* and *Ne* revealed some interesting features common to all gases. (1) The gross intensity of the system in all the gases increases with increase of pressure in the initial stage and reaches a maximum (except in *He*) at a certain pressure ( $P_{max}$ ). (2) The decrease in intensity after  $P_{max}$  continues for further higher pressures till a pressure  $P_{min}$  is reached after which a significant rise in intensity is noted. Simultaneous with this minimum is observed the occurrence of constriction of the discharge. These values of  $P_{max}$  and  $P_{min}$  are different in different gases.

From this comprehensive study of the system it has been possible to visualise the above phenomenon of  $P_{max}$  and  $P_{min}$  on the basis of (1) electronic excitation, (2) activation-deactivation processes by collisions of the 2nd kind and (3) constriction of the discharge, which lead to the possible processes of the excitation of the bands in rare gases.

### 18. Swan Bands in Rare Gases : Part II-Role of the nature of rare gas and its pressure in transition probabilities.

V. RAJESWARI AND N. R. TAWDE, Dharwar.

A set of experimental transition probabilities is deduced from an extensive study of intensity distribution in the  $C_2$  ( $3\pi - 3\pi$ ) system excited in discharge through all the rare gases under controlled conditions. It is apparent from the different sets of values for each gas that neither the nature of the gas nor its pressure has any effect on the transition probabilities considering the limits of experimental error. These values have been compared with the corresponding values obtained in other sources and with those periodicted theoretically. Conclusions have been drawn regarding the performance of the theories and experiments on the system.

### 19. Estimation of Electron Energy in H.F. Discharge in $H_2$ . Part I-Probe Method.

G. K. MEHTA AND N. R. TAWDE, Dharwar.

The mean energy of electrons in H.F. discharge in hydrogen has been determined by modified probe method using an additional anti-probe. The discharge was studied (i) 3.6. Mc/s and (ii) 18 Mc/s in cylindrical tube fitted with external sleeve electrodes and filled with mercury-free hydrogen at different pressures, ranging from 0.03 mm. to 0.25 mm. of *Hg*. The modified probe method gives abnormal characteristics which cannot be analysed in the usual way. These characteristics have been interpreted and analysed by a new method on the assumption of Maxwellian distribution of energy among the electrons which is confirmed by experiments. The new method of analysis removes the uncertainty introduced by the changing of potential at the anti-probe and enables precise determination of the mean electron energy  $V_e$ . The values of  $V_e$  obtained lie in the range of 8 to 10 e.v.

### 20. Estimation of Electron Energy in H.F. Discharge in $H_2$ . Part II-Spectroscopic Method.

G. K. MEHTA AND N. R. TAWDE, Dharwar.

The mean electron energies in H.F. discharge in hydrogen have been determined by spectroscopic method suggested by Brasefield, involving the measurement of the



intensity ratios of certain singlet and triplet lines in the secondary spectrum of hydrogen. The discharge has been studied under the same conditions as in probe measurements—(Part I). The curves showing the variation of intensity ratios of four pairs of lines with energy of the exciting electrons, worked out experimentally by Brasefield (at 0.03 mm. pressure) for uniform energies of the electrons, have been modified for Maxwellian distribution. The values of mean electron energy  $V_e$  found by using these curves work out much lower as compared to those found from Brasefield's original curves. It is only at 0.03 mm. pressure that the four ratios give consistent values of  $V_e$ . The value of  $V_e$  for this pressure at 3.6 Mc/s and 18 Mc/s also compare well with those obtained by the electrical probe method. At higher pressures the ratios give values which are not consistent among themselves.

## Electric Discharge Phenomena

### 21. The Streamer Mechanism and the Sparking 'Threshold.'

S. R. KHASTGIR AND C. M. SRIVASTAVA, Banaras.

A modified mechanism of the streamer propagation has been proposed to explain certain experimental results which are contrary to the original streamer theory of Loeb & Meek. It has been shown that the backward pull on the electron avalanche due to the positive ionic concentration is indeed appreciable and this results in the checking of the electron avalanche as it proceeds towards the anode. When the electrons in the avalanche are thus checked at a certain distance, some of the electrons diffuse back into the positive ionic concentration due to the mutual repulsion, thereby decreasing the backward pull on the electron avalanche and allowing the rest of the electrons to continue their journey towards the anode. At some further distance, the electrons are checked once again due to the backward pull on them, and due to diffusion of some electrons back into the positive ionic concentration, the backward pull is decreased, allowing once again the electrons in the avalanche to continue in their journey to the anode. The process is repeated a number of times before the avalanche reaches the anode. The modified theory explains Fisher and Bederson's observations on time-lag. The 'threshold' potential has also been found and is shown to have the conventional Townsend form. The theoretical value of the 'threshold' is found to be half that given by Loeb & Meek and is in conformity with the recent experimental results. It is also found that the theoretical value of  $\gamma$  for air is of the same order of magnitude as the experimental value given by Townsend.

### 22. On Geiger Region of A/C Electric Discharge.

H. C. GAUR AND N. A. RAMAIAH, Delhi.

The variation in the potential width of Geiger or non-self-maintained region of a/c electric discharge with the nature of the electrode surface was studied in cylindrical tubes fitted with external sleeve electrodes. The discharge tubes were filled with pure iodine vapour (0.45 mm. Hg) and excited by 50 cycle potentials. A cathode ray oscillograph was employed to scan the Geiger region over which current pulses due to external radiation were of the same height. In freshly prepared discharge tubes, the Geiger region extended over a few thousand volts; thus in one series of experiments, it was from 650 to 2500 volts. Its width decreased appreciably with

'ageing', temperature and films like KCl, etc. Further, removal of pre-adsorbed layers like  $\text{H}_2\text{O}$  vapour, etc., from the electrode walls also inhibited the plateau.

### 23. Influence of the Nature of the Electrode Material on Joshi Effect in Nitrogen.

P. K. TIKOO, Banaras.

Three Geissler tubes A, B and C fitted with Pt, Au and Ag wire electrodes respectively (in each case  $d=56$  mm) were employed. In A at  $p\text{N}_2=4$  mm. large positive Joshi effect,  $+\Delta i$  could be observed near the threshold potential.  $\% \Delta i$  decreased progressively as the gas pressure was increased, finally became zero at 30 mm; and remained so though the pressure was increased to 150 mm. In B and C no  $\Delta i$  could be detected at any of these pressures. It was, however, interesting to observe that after prolonged 'aging' at these relatively high pressures when the same was lowered to 50 mm, practically 100% photo-suppression of the discharge current could be observed in A over a wide range of applied potential. As the pressure was lowered further to 40 mm,  $-97$  to  $-100\%$   $\Delta i$  could be observed in A over the entire range of applied potential studied. B and C again did not exhibit any  $\Delta i$ . This last can be attributed to a greater sputtering or/and a chemical reaction of the excited gas with the electrode material. The disintegration of the momentary cathode under the influence of positive ions received by it from the cathode dark space leads to deposition of the cathode material on the walls, making the same equi-potential. This can inhibit the emission of photo-electrons from the walls, the same having been found to be fundamental to the production of  $\Delta i$ .

### 24. A Thermionic Analogue of Joshi Effect in Nitrogen.

P. K. TIKOO, Banaras.

A Geissler tube (inner diameter=34 mm) was fitted with a Pt plate [H.T. electrode] and a Pt wire filament [L.T. (grounded) electrode] 53 mm apart. The filament, which could be heated to redness by a 3.8 amp. current from an independent source, was provided with a glass shield (diameter=20 mm) which could be slid 2 cm in front of it and an equal distance behind it, by means of an externally operated magnetic field.

The suppression of the discharge current, as a result of thermionic emission, ( $\Delta i_T$ ), was similar to the widely observed negative Joshi effect, which is a photo-suppression of the discharge current,  $i$ . Like the latter, it was most pronounced near the threshold potential than at higher applied potentials.

Shielding the L.T. electrode resulted in a marked decrease in  $i$ , ( $\Delta i_s$ ), the same being more marked when the filament was hot. This last can be attributed to a loss of current carriers to the walls of the shield, as a result of greater ambipolar diffusion. The electrons and positive ions drawn to the walls will there, by three body impacts, quickly be neutralized. The greater magnitude of  $\Delta i_s$ , while the filament is emitting thermo-electrons, can thus be explained.

### 25. An Oscillographic Study of the Time Disparity in the Production and Annulment of the Joshi Effect

H. J. ARNIKAR, Banaras.

Hydrogen at a pressure of 25 mm Hg was excited in an all-glass ozonizer by D.C. potentials in the range 1—1.5 kV under conditions productive of 100% negative



Joshi effect. An oscillographic study showed that the current in dark consisted of a number of unidirectional pulses varying in amplitude from 2—3 (minimum) to 20 (maximum) scale divisions. Immediately on irradiation, *all* the pulses were suppressed completely with an undetectable time lag. On cutting off the light, however, the different amplitude group pluses appeared *progressively*, and not simultaneously. The shortest (2—3 div.) pulses appeared almost immediately, the medium (10—15 div.) ones followed them after a small but distinct lag, and the highest (20 div.) pulses were the last to be restored. These observations were typical of the range examined and substantiate results reported earlier by the author for the time disparity in the production *in full* and the corresponding annulment of the Joshi effect.

## 26. The 'Corona Pressure' and the Thermionic Analogue of Joshi Effect in Hydrogen.

H. J. ARNIKAR AND R. J. GALAGALI, Banaras.

The thermionic analogue of the Joshi effect  $(\Delta i)_T$  and the 'corona pressure'  $(\Delta p)$  were studied in  $H_2$  over the pressure range of 1–500 mm. The gas was excited in a Maize type counter with a central Pt wire earthed and kept (a) cold and (b) heated to emission state by an independent source of current. In the lower pressure range (20–120 mm)  $(-\Delta i)_T$  was 100% at the threshold potential due to thermo-electrons on the central wire analogous to the negative Joshi effect under light. At two pressures, *viz.*, 121 and 402 mm. the co-occurrence of  $(-\Delta i)_T$  and  $\Delta p$  was observed in the potential range 5.2–5.7 kV. At 5.7 kV the values were 20% and 0.18 mm. for  $(-\Delta i)_T$  and  $\Delta p$  respectively. Corresponding values at 402 mm. were –13% and 0.35 mm. At still higher pressures  $(+\Delta i)_T$  and  $\Delta p$  co-occurred.  $(\Delta i)_T$  data were also confirmed oscillographically.

## 27. Effect of Aging under discharge of the Resistance of Platinum Electrode.

H. J. ARNIKAR AND R. J. GALAGALI, Banaras.

The problem arose during the study of the *thermionic analogue* of the Joshi effect and 'corona pressure' in hydrogen excited in a Maze counter-like tube with a 10 cm central Pt wire which could be heated to emission state by current from an independent source. Continued working of the tube with progressively increasing gas pressure in the range 1–15 mm, resulted in a reversible lowering of the normal electrical resistance of the Pt wire. The wire which could be heated to a dull reddish glow at 4 A and to a white glow at 5 A, now did not glow even faintly at 5 A, with or without the discharge. With gas at 1 mm pressure and unexcited, the potential across the cold wire for a current of 2 A, fell to 150 from 250 mV, the corresponding value in vacuum, showing a change of resistance of –40%. Evacuation of the tube at this stage restored the normal resistance of the wire, as indicated by the potential rising to the initial value of 250 mV for the same current. Also, the wire could glow now at 5 A as before. Once initiated by sufficient aging under discharge, the change of resistance of the Pt wire was reversible *ad libitum* between vacuum and even a trace of hydrogen.

Results were similar with a tube excited with external sleeves in which the central Pt wire did not form part of the discharge circuit, though surrounded by excited gas.

## General Properties

### 28. The Absorption Coefficients Of $\text{Co}_{60}$ Gamma-Ray.

N. K. GANGULY AND A. M. GHOSH, Calcutta.

Absorption coefficients were measured using  $\text{Co}_{60}$  Gamma-Rays (1.16 Mev and 1.31 Mev) for Pb, Cu, Al, I, Br, CuO etc. The absorbers were selected from purest material available. The detector was a cylindrical Geiger-Muller counter having copper cathode of 2" diameter. The geometry of the apparatus was such as to cut the degenerate radiation resulting from large and small angle scattering to at least an order less than the statistical error. The solid angle subtended by the absorber placed at mid-point between the source and the detector being  $3.5 \times 10^{-5}/4\pi$ . The source used was a cobalt sphere of diameter .63 cm. and of strength 60 mc. The gamma-ray beam was collimated by lead discs of total thickness 25.7 cm. The dia-meter of the four discs were 51 cms. Whole arrangement was mounted on wooden structure and was placed so that the scattering of gamma-rays by floor and nearby objects were negligible. The counter was fed with a well regulated voltage source. To account for the counting losses the counter was kept 'dead' for 150 sec. after each recorded count. The absorption coefficients show agreement within 1% of the theoretical values.

### 29. Study of the Current Voltage Characteristics of $n$ - $p$ Contacts in Galena.

P. V. KHANDEKAR AND J. N. DAS, Nagpur.

Rectifying constants between a metal whisker and a crystal of  $n$  or  $p$  type, as well as  $p$ - $n$  junctions have been studied in considerable details by a number of workers. We have studied, in some detail, the characteristics of contacts between  $p$  type crystals of galena and  $n$  type crystal, with a small area of contact. It is interesting to note that these contacts are efficient rectifiers with rectification ratio of the order of 500 at 1 volt. Analysis of the forward characteristics of such contacts shows that the semi-log plot of the current and the voltage applied to the barrier yield the theoretically expected slopes  $\alpha = e/kT$  (40 volt $^{-1}$  at 300° K) and a comparatively high value of spread resistance  $R_s$ . The high value of  $R_s$  shows that the actual contact area must be small. The system is equivalent to a number of  $n$  type contacts with a  $p$  type crystal. It is significant to note that these multicontacts should give a theoretical value of the slope, in view of Yearian's postulates of the multicontacts to reduce the value of  $\alpha$ .

### 30. Dielectric Constant and Dipole Moment of the Esters of Monocarboxylic Acids. (part II).

S. K. K. JATKAR AND V. K. PHANSALKAR, Poona.

In the present paper, the dielectric constant, density and refractive index of pure methyl and ethyl benzoate, methyl and ethyl salicylate and ethyl chloroformate were measured at different temperatures in liquid state. The values of the dipole moment are calculated by applying the new equation given by Jatkar and the results are compared with those obtained by Onsager's equation. The dipole moment of methyl and ethyl benzoate is 1.7  $D$ , of methyl and ethyl salicylate is 2.2  $D$  and of ethyl



chloroformate is 2.1 *D*. The moments are practically independent of temperature. The results are discussed on the basis of molecular structures.

### 31. Dielectric Constant and Dipole Moment of the Esters of Dicarboxylic Acids.

S. K. K. JATKAR AND V. K. PHANSALKAR.

In the present paper the dielectric constants, refractive index and density of pure di-ethyl oxalate and diethyl malonate were measured at different temperatures. The dipole moment was calculated by applying the new equation given by Jatkár. The old data for diethyl succinate, diethyl glutarate, diethyl adipate, diethyl azelate and diethyl sebacate was recalculated by new equation.

The value for the diethyl esters is 2.1 *D* though pure diethyl oxalate, malonate and adipate show a moment of 2.25 *D*. This slight increase might be due to the effect of intermolecular and intramolecular action.

The observed moment is explained by taking the rotation of the two  $\text{COOC}_2\text{H}_5$  groups along C-C linkage.

### 32. Dielectric Constant of Liquids and Dipole Moment. Aldehydes (part III).

S. K. K. JATKAR AND C. M. DESHPANDE, Poona.

The application of new equation to the data on dielectric constants of benzaldehyde, salicylaldehyde, and cinnamaldehyde in pure liquid state gives 2.97, 3.30, and 3.09 as the values of the moments for benzaldehyde, cinnamaldehyde and salicylaldehyde respectively. These values are practically constant over the range of temperature investigated. The moment of anisaldehyde in benzene solution is found to be 3.26 which is independent of temperature and concentration. The moments are interpreted in the light of the new theory on induction and dipole moment suggested by the authors.

### 33. Resonance Energy and Ultrasonic Dispersion from Molecular Spectra.

S. K. K. JATKAR AND D. D. DESHPANDE, Poona.

In this paper the resonance energies of benzene, carbon dioxide, carbon disulphide, etc., have been calculated from the fundamental frequencies of these molecules which are ascribed to the various linkages in the resonance structures.

The ultrasonic dispersion has also been found to be quantitatively due to London inter-molecular forces, calculated from the molecular frequencies from Infrared and Raman spectra, as well as electronic frequencies derived from ionisation potentials.

### 34. Etching of metal and alloy crystals under cathodic sputtering.

P. G. DEO, Lucknow.

Multiple-beam interferometry was applied to study the etching of metal and alloy crystals under cathodic sputtering. The alloy (or metal) was taken in the form of a flat cylinder (diameter 1.5 cm; length 1 cm). It was polished mechanically over various grades of emery paper and finally over a polishing cloth and was made the

cathode of the sputtering unit built of aluminium parts. In a flushing atmosphere of argon (pressure 0.1 mm), the sputtering was carried out at as low a rectified applied potential as possible, employing a cathode-anode gap of 1.5 cm. Different metals and alloys were used as cathodes. The etched surface in each case was examined by microphotography, multiple-beam interferometry and light profile techniques.

Interesting results were obtained with alloys of tin and antimony. The alloy components were found to sputter differentially the grain and subgrain boundaries were revealed. Measurements of depressions and hillocks were made. The results were compared with the usual metallurgical chemical etching.

### 35. Study of the dispersion of some gaseous Organic Compounds.

R. V. JOSHI, Baroda.

This paper deals with the measurement of refractivities for certain organic compounds like Carbon tetrachloride  $\text{CCl}_4$ , Chloroform  $\text{CHCl}_3$ , Methyl iodide  $\text{CH}_3\text{I}$ , and so on in the gaseous state. The dispersion caused by these compounds has been determined over six different wavelengths, in the visible region, using the Mach-Zahender interferometer in preference to the usual Jamin interferometer. The method adopted for representing the results is that which shows the refractivities of the respective gaseous substances for the same number of molecules per unit volume as hydrogen contains at N.T.P. The usual Sellmeier dispersion formula has been used to summarize the results of the dispersion measurements and in all cases a single term was found to be sufficient.

### 36. Ultrasonic Velocities in solutions of Iodine in Aqueous Solutions of Potassium Iodide.

B. RAMACHANDRA RAO AND V. LAKSHMINARAYANA, Waltair.

Ultrasonic velocities in opaque solutions can be determined by the liquid film method with advantage. A solution of iodine in potassium iodide is opaque and the liquid cell method is used to determine the ultrasonic velocities in the solution with iodine content. The velocity is found to increase with iodine content first and then decreases as the iodine content is increased further. The velocity is found to exhibit a maximum. The same sort of behaviour is met with when the molar concentration of potassium iodide is doubled. The velocity again exhibited a maximum but the iodine concentration at which this occurs is found to shift towards higher concentration side.

### 37. Study of Electrolytic Dissociation by X-Ray diffraction-II.

P. N. SHARMA, S. N. DUTTA AND S. R. BHATTACHARYA, Lucknow.

X-ray diffraction studies of aqueous solutions of acid salts at various concentrations have been extended in case of potassium bi-sulphate solutions especially at higher dilutions with a view to making a more searching probe in the vicinity of the 'critical dilution at which the second stage of ionisation sets in. Using the  $\text{Cu-K}\alpha$  radiation and the powder photograph method, a remarkable series of photographs has been obtained which portray all the changes taking place. In concentrated solutions,  $\text{KHSO}_4$  forms a ring of its own slightly larger than the water ring. With increasing



dilution the ring becomes smaller, broader, and fainter. N/4 solution gives only a diffraction corona surrounding the central spot, the diameter of its edge corresponding roughly to that of water. At further dilutions, the ring reappears and the pattern gradually approximates to that of pure water. The diffraction patterns have been interpreted on the concept of a 'rearrangement of water molecules in the electric field of the ions' as proposed by Bernal and Fowler. It has been pointed out that the stepwise dissociation of potassium bi-sulphate is responsible for the observed changes in the X-ray patterns. An attempt has been made to compare the results with those obtained in case of sodium bi-sulphate solutions.

### 38. pH determination of Iodic acid solutions.

J. R. SARAF AND K. N. VAISH, Lucknow.

Nayar and co-workers have reported breaks in the curves of the physico-chemical properties of iodic acid solution. Such breaks occur at about 0.04N and 0.09N which they interpret as transition points in the polymerisation of  $\text{HIO}_3$  molecules.

Raman effect study of iodic acid solution of concentration ranging from 4.5N to 0.03N was made by one of the authors and results obtained were in agreement with the above interpretation.

In the present work, a determination of pH value of iodic acid solutions of different concentrations was made with the help of a pH meter assembled in the laboratory. The pH values so obtained were plotted against the corresponding concentrations and the curve so obtained shows breaks at 0.08N and 0.04N in agreement with Nayar's interpretation.

## Non-Experimental

### 39. Semi-empirical formulae for the Thermal diffusion factor of mixtures with one invariable constituent.

B. N. SRIVASTAVA AND S. C. SAXENA, Calcutta.

The variation of the thermal diffusion factor  $\alpha$  for binary mixtures of inert gases, when one constituent is kept fixed and the other varied, has been investigated and semi-empirical formulae have been derived for the variation of  $\alpha$  with the proportionate mass difference of the molecules. These results have been explained in terms of the Chapman-Enskog formula for the case of Lennard-Jones 12 : 6 model by utilising the experimentally obtained unique dependence of the force constants  $\epsilon_{ij}$  and  $r_{ij}$  on the molecular mass of the variable constituent for a given series of mixtures. The same considerations have been applied to isotopes of monatomic and diatomic molecules and suitable formulae have been deduced for  $\alpha$ ,  $\epsilon_{11}$  and  $r_{11}$ . The formulae have been tested by calculating the force constants of radon.

### 40. Intermolecular Force constants for an Exponential Potential Energy Function.

M. P. MADAN, Lucknow.

The viscosity and thermal diffusion data of various isotopic gases have been examined to study the nature of the law of molecular interaction on the basis of an

exponential potential energy function, which is a more realistic potential form than any other used hitherto. The temperature variation of these transport coefficients has been used to obtain the constant  $\varepsilon$ , which represents the maximum negative energy of interaction of two molecules. The intermolecular separation  $r_m$ , for maximum interaction energy has been calculated by actual substitution. The effect of second approximation to the thermal diffusion ratio on the intermolecular force constants has also been studied. It has been found that the conclusions are in accord with the author's previous statement made in an earlier paper. (Proc. Ind. Sc. Cong. 3, 1953).

#### 41. A Study of temperature Variation in convected Air-streams.

H. N. PATIL, Visnagar AND D. V. GOGATE, Baroda.

In this paper, the problem of temperature decay of forcibly convected air has been treated theoretically by making use of dimensional analysis. The effect of air-velocity on temperature decay has been considered and the following relation between the variation of temperature, air-velocity and heat output has been obtained :—

$$\Delta\theta = \frac{KQ^{2/3}}{h^2} (hv+a)^{-1.3}$$

Here  $\Delta\theta$  is the temperature variation at a height  $h$  from the heat source,  $v$ =the air-velocity,  $Q$ =heat output,  $a$  is a correction factor and  $K$  is a constant. The experimental data from the observations of A. O. Rankine are utilized to plot  $\log$

$\left( \frac{\Delta\theta h^2}{Q^{2/3}} \right)$  against  $\log (hv+a)$ .

It is found that by choosing a suitable value for the correction term  $a$ , the graphs come out to be straight lines in all cases, proving thereby the correctness of the above theoretical relation.

#### 42. On the Gravitational Field of an Isolated Fluid Sphere.

R. V. WAGH, Poona.

The physical properties of an isolated fluid sphere in general Relativity are studied here with the help of the line-element, *viz.*,

$$ds^2 = -e^{\mu}(dr^2 + r^2 d\theta^2 + r^2 \sin^2 \theta d\phi^2) + e^{\nu} dt^2 \quad \dots (i)$$

The fluid sphere is assumed to be homogeneous and isotropic. Energy has a finite value at the boundary of the fluid sphere and is zero at infinity. Gravitational field equations are derived for the conditions stated above—using the primitive of the equation, *viz.*,

$$y'' - \frac{1}{r} y' + \phi(r)y^2 = 0 \quad \dots (ii)$$

in the form

$$y = \frac{b}{a} \frac{\{(\sqrt{3}+1)C_{nu} + (\sqrt{3}-1)\}}{(C_{nu}-1)} \quad (iii)$$

Lastly the conservation of energy is also considered,



43. On the classical theory of the motion of charged particles and the electromagnetic-field.

N. D. SENGUPTA, Bombay.

The problem of the motion of charged particles and the electromagnetic field may be described by the solutions of the simultaneous equations, namely field and particle equations,

$$\left( \frac{\partial}{\partial x_\nu} \cdot \frac{\partial}{\partial x_\nu} \right) A_\mu = -\frac{4\pi}{c} S_\mu.$$

$$\frac{d}{ds} U_\mu = \frac{e}{m_0 c} F_{\mu\nu} U_\nu.$$

with the particular solution of  $A_\mu$

$$A_\mu = A^\circ_\mu + A'_\mu$$

where  $A^\circ_\mu$  describes the external field, and is solution of the homogeneous equation for  $A_\mu$ , and  $A'_\mu$  is the other part of the field which contains  $u_\nu$ 's and their derivatives. This part of the field consequently has a contribution to the ponderomotive force and is usually called radiation resistance. This formalism is very useful for most of the practical purposes. But, the introduction of the idea of an external field makes the investigation restricted only to a part of the system and hence one can never expect a complete description of the phenomenon with it.

As a preliminary step, the problem for a closed system, (in the sense that there is no external field and the object is the investigation of the motion of a system of charged particles and the field, with mutual interaction), may be described by the solution of this simultaneous equations

$$\begin{aligned} \left( \frac{\partial}{\partial x_\nu} \cdot \frac{\partial}{\partial x_\nu} \right) A_\mu &= -\frac{4\pi}{c} S_\mu \\ \frac{d}{ds} U_\mu^{(n)} &= \frac{e^{(n)}}{m_0^{(n)} c} F_{\mu\nu} u_\nu \end{aligned}$$

( $n=1,2,3,\dots,r$ ,  $r$  being the total number of particles in the system)

with the trivial solution ( $A^\circ_\mu=0$ ) of the corresponding homogeneous equations for  $A_\mu$ .

In this formation the system is looked upon as a whole consisting of the charges as well as the field produced by them, *i.e.*, charge and field being inseparable entites.

44. On the problem of softening and polarisability of radiation in an electron atmosphere, scattering according to Rayleigh's Law and involving multiple Compton scattering.

K. K. SEN, Chandernagore.

The problem of softening of radiation due to multiple Compton scattering in an axially symmetric, plane parallel electron atmosphere, scattering according to Rayleigh's law and involving polarisation of the radiation field has been solved in the first

approximation by the method of trigonometrical series. The intensity distribution and the distribution of the degree of polarisation of the outcoming radiation have been calculated and the former has been compared with the corresponding distribution in the case of non-polarised light. The use of trigonometrical series for finding the optical thickness of such an atmosphere has also been considered.

### Apparatus and Instruments

45. A dielectric lens with a parabolic reflector for Radar Transmitters working on *S* and *X* bands.

V. V. RAO, Khargpur.

For receiving a large amplitude of reflected signal from the target a highly directional radiating antenna system is necessary. A highly directional beam is obtained by using a parabolic reflector with dielectric lens. A method useful for producing a narrower and intense beam is outlined. In this case a plane wave obtained from a spherical one is projected on a dielectric lens for correcting the width of the beam, a lens in turn does not allow the beam to diverge.

The required effective range of the beam can be obtained by adjusting the focal length of the lens at the time of manufacture. The main advantage of the system is that high strength echoes, at the cost of comparatively low-power and with a greater efficiency, are obtained.

46. A Simple Viscometer.

K. R. CHAUDHARI AND D. V. GOGATE, Baroda.

In this paper, a simple method for determining the viscosity of an appreciably viscous liquid is described. A solid brass cylinder fixed to a wire, the other end of which is clamped to a rigid support, is allowed to oscillate in a viscous liquid placed in a wide beaker. The cylinder is initially twisted through a certain angle and is then allowed to untwist itself and to rotate in the viscous liquid. The work done in twisting the cylinder (and the wire fixed to it) is used in overcoming the viscous resistance of the liquid, through which the cylinder rotates, while the wire is being untwisted. An equation for the energy difference between two positions of the rotating cylinder, is then obtained in terms of the deflections of the cylinder, rigidity of the wire, the radii of the cylinder and the wire and the viscosity of the liquid. The constant of the apparatus used, is first calculated with reference to some standard liquid whose viscosity is accurately known and using this constant, the viscosities of other liquids can be easily determined. Considering the simplicity of the method, the values of viscosity obtained are found to be fairly satisfactory.

47. A Method of Testing Musical Tuning and Intonation with "Automatic Musical Instrument".

H. V. MODAK, Poona 1.

The author has devised a string instrument named "Automatic Musical Instrument" which plays musical accompaniment to vocal or any other music. The working of the instrument is based on resonance and therefore it stops working when the



note sung is out of tune. The instrument serves as a means for testing musical tuning and intonation, provided the strings of the instrument are first accurately tuned. The paper describes a method for tuning strings of the instrument using an audio oscillator (which need not be a calibrated one) and a rectifier circuit which produces a series of harmonics. This method does not require musically trained ear.

The oscillator note of frequency " $n$ " can excite strings tuned to frequencies  $n$ ,  $2n$ ,  $3n$ , etc., by the harmonics produced. Therefore if two strings are so adjusted that they are set in vibrations, for the same setting of the oscillator, the first by the fourth harmonic and the second by the third harmonic of the oscillator note, then they are correctly tuned in the ratio of  $4/3$ . As the different notes in a musical scale are interrelated by simple frequency ratios, the tuning of all strings is similarly possible.

#### 48. A peculiar optical transmission property of ordinary glass.

V. RAMAKRISHNA RAO AND C. V. NARAYANA RAO, Waltair.

It is well known that both pyrex and ordinary glass do not transmit radiations below  $\lambda$  3100 A.U. It is, however, observed by the authors that the McLennan bands in the fluorescence spectrum of iodine vapour could be obtained on irradiating the vapour with radiations from a thallium spark, even when a pyrex or ordinary glass plate is introduced between the fluorescence tube and the spark. It was experimentally established by McLennan that these Mc bands could be obtained only on excitation with wavelengths below 2100 A.U. To verify how these Mc bands were obtained in our experiment, a direct picture of thallium spark is recorded with a wide and a long exposure (60 hrs.), with and without the glass plate covering the slit of the spectrograph. The glass plate cut off entirely the radiations in the region  $\lambda\lambda$  2900–2050 A.U., while transmitting the spark lines at 2012, 2004, 1950 A.U. Similar transmission of wavelengths below 2050 A.U. in mercury arc source was not observed. Hence it might be concluded that transmission of thallium lines (below 2050 A.U.) through ordinary and pyrex glass is peculiar to thallium spark source

## SECTION OF CHEMISTRY

*President* :—A. C. CHATTERJI, D.Sc., Dr. Ing.

### *Abstracts*

#### ANALYTICAL CHEMISTRY

##### 1. Colorimetric Determination of Iron with p-Amino-Salicylic Acid (Sodium Salt).

AJITKUMAR MUKHERJEE, Calcutta.

The paper introduces p-Amino-salicylic acid (sodium salt).  $C_7H_6NO_3Na \cdot 2H_2O$ , as a new sensitive, stable and widely applicable colorimetric reagent for ferric iron. During the systematic investigation of a series of Inner-Metallic Complex salts (Ray and Mukherjee, J. Indian Chem. Soc. 27, 707, 1950) of salicylalmino acids with metals like copper, nickel, cobalt, manganese and iron, it was observed that p-Amino-salicylic acid (sodium salt) reacts with ferrous and ferric iron to give deep violet-red colouration. Careful studies of the reactions of this ligand with ferric iron showed that it is well suited for the colorimetric estimation of the latter. The colour intensity given by ferric iron in solution is fairly high, permitting detection and estimation of a very small amount of iron (III).

The maximum absorption for the colour of the iron complex was found to lie between 480-500  $m\mu$  at pH 1.4-3.05 and between 450-470  $m\mu$  at pH 3.36-9.86. The colour produced was found to obey Beer's Law over a wide range of concentration (0.05 to 15 p.p.m.) and remains stable for a long period of time. The optical density of the coloured solution has been found to diminish slightly below 20°C. (sensitivity: 0.09  $\gamma/cm.$  i.e.  $pD=7.05$ ).

All measurements were made in a Unicam spectrophotometer (S.P. 600, using 1 cm. glass cells). All pH determinations were made with Cambridge Bench type pH meter. The influence of different foreign ions upon the colour intensity was also studied. The reagent gives an intense red colouration with  $UO_2^{2+}$  ion which, therefore, interfered in iron determination even when present in quantities of 2 p.p.m. Copper, nickel, have been found to have marked influence. Phosphate,  $HPO_4^{2-}$ , borate,  $BO_3^{2-}$ , fluoride, chromate and  $MoO_4^{2-}$  ions have been found to interfere strongly due to complex formation.

##### 2. A Critical review of the Methods for the Colorimetric Estimation of Chromium.

J. XAVIER, AMIYA KUMAR CHAKRABURTTY and PRIYADARANJAN RAY,  
Calcutta.

A detailed critical examination of almost all the known methods for the colorimetric estimations of chromium has led to the determination of the optimum conditions, exact range of applications and the degree of usefulness of those methods and their respective sensitivities.

The natural yellow colour of the chromate ion in alkaline medium serves as a very useful means for estimating chromium at 370  $m\mu$ , the wavelength of maximum absorption. Beer's law is obeyed at all concentrations. Sensitivity 0.01  $\gamma$  Cr. per  $cm.^2$  ( $pD=8$ ).

Chromium can also be estimated in acid medium utilising the natural colour of the dichromate ion. Beer's law is obeyed at 455  $m\mu$ . The method is less sensitive than the chromate method and the colour intensity decreases with increase in



acidity, but is almost constant above 0.9N sulphuric acid. For estimation of chromium in steel, the use of perchloric and phosphoric acids has been recommended. Sensitivity (in  $\text{H}_2\text{SO}_4$ ) 0.26  $\gamma$  Cr. per  $\text{cm}^2$  ( $\text{pD}=6.59$ ).

s-Diphenyl carbazide is by far the best and the most sensitive reagent for the colorimetric estimation of chromium. The estimation is to be carried out in the pH range 1.2 to 2.6 at 540  $\text{m}\mu$ , the wavelength of maximum absorption. The use of phthalic anhydride helps in preventing the oxidation of the reagent. Beer's law holds good and very small amounts (0.01 p.p.m.) of chromium can be accurately determined. Sensitivity 0.0015  $\gamma$  Cr. per  $\text{cm}^2$  ( $\text{pD}=8.8$ ).

Chromotropic acid (sodium salt), in 0.5 to 5N sulphuric acid, gives a cherry-red colour with chromium (VI), which obeys Beer's law at 390  $\text{m}\mu$ . The method, though quite sensitive, suffers due to the instability of the colour. Sensitivity 0.016  $\gamma$  Cr.  $\text{cm}^2$  ( $\text{pD}=7.8$ ).

The emerald-green colour of  $\text{Cr.+++}$  ion obtained by reducing chromium (VI) with sodium pyrosulphite ( $\text{Na}_2\text{S}_2\text{O}_5$ ) can be measured at 430 or 610  $\text{m}\mu$ , where Beer's law is obeyed. The method is rapid but not sensitive. Sensitivity 2  $\gamma$  Cr. per  $\text{cm}^2$  ( $\text{pD}=5.7$ ).

Chromic salts when boiled with oxalic acid form the soluble violet coloured trioxalato-chromiate complex and this serves as a very rapid means of estimating chromium specially in tanned leather. Measurements are to be made at 420  $\text{m}\mu$  and if iron be present, at 560-570  $\text{m}\mu$ . Beer's law holds good above 30 p.p.m. Cr. Sensitivity 0.7  $\gamma$  Cr. per  $\text{cm}^2$  ( $\text{pD}=6.16$ ).

Methods based on the oxidation of some of the organic compounds, such as hematoxylin,  $\alpha$ -naphthylamine, p-phenitidine hydrochloride and aniline sulphate, by chromium (VI) have been found to be unsuitable for spectrophotometric studies, as the colours thereby obtained are not quite stable. They may, however, be suitable for the detection and visual estimation of chromium.

The green colour obtained by dissolving chromic phosphate in mineral acids may be used for estimating very large amounts of chromium (430  $\text{m}\mu$ ). This method is of little value as the sensitivity is 10  $\gamma$  Cr. per  $\text{cm}^2$  ( $\text{pD}=5$ ).

### 3. A Critical Review of the Methods for the Colorimetric Estimation of Palladium.

J. XAVIER, AMIYA KUMAR CHAKRABURTTY and PRIYADARANJAN RAY,  
Calcutta.

Some of the important methods for the colorimetric estimation of palladium have been subjected to a thorough critical examination for judging their respective merits.

p-Nitroso dimethyl aniline or p-nitroso diethyl aniline serves as useful and sensitive colorimetric reagents for palladium. The deep red colour is measured at pH 4.8 at 525  $\text{m}\mu$ , where Beer's law is obeyed. But the colour is decreased in presence of neutral salts. 1 c.c. of a 0.25% solution of the reagent in 1:1 alcohol is recommended for estimating up to 2 p.p.m. Pd. Sensitivity 0.0016  $\gamma$  Pd per  $\text{cm}^2$  ( $\text{pD}=8.8$ ).

p-Nitroso diphenylamine also gives a dark purplish brown colour with  $\text{Pd}^{++}$ , but the colour takes time to develop and the method can not be worked above pH 2.1, due to precipitation, although the colour development is maximum near about pH 3. The method is suitable for visual colorimetry. Spectrophotometric estimation can be made using a standard curve.

The pink colour formed by  $\text{Pd}^{++}$  in presence of a large excess of potassium iodide, has been utilised for estimating small amounts of palladium colorimetrically. The solution must be acidic (below 2N HCl or  $\text{H}_2\text{SO}_4$ ) and the wavelength of maximum absorption is 408  $\text{m}\mu$ . Beer's law holds good at all concentrations. Use

of sodium sulphite solution prevents the slow variation in colour intensity due to the liberation of iodine. Sensitivity  $0.011 \gamma \text{ Pd per cm}^2$  ( $pD=7.96$ ).

Thioglycollic acid gives a yellow colour with  $\text{Pd}^{++}$  which remains unchanged in the pH range 0.90 to 9.5. Measurements may be made at 365 or 370  $m\mu$ . Beer's law is obeyed at all concentrations of palladium. The method is quite sensitive and reliable. Sensitivity  $0.02 \gamma \text{ Pd cm}^2$  ( $pD=7.7$ ).

#### 4. A Critical Review of the Methods for the Colorimetric Estimation of Titanium.

J. NAVIER, AMIYA KUMAR CHAKRABURTTY and PRIYADARANJAN RAY,  
Calcutta.

Most of the methods described in literature for the colorimetric estimation of titanium have been critically examined in order to ascertain their usefulness and ranges of applicability. In the course of this work a Unicam SP. 600 Spectrophotometer and a Cambridge pH meter (Bench Type) have been used to measure the absorbancy and the pH values respectively.

The yellow colour produced by  $\text{Ti}^{++++}$  with hydrogen peroxide in presence of sulphuric acid (1.5 to 3.8N) can be utilised to estimate up to 50 p.p.m. Ti at 410  $m\mu$ . Beer's law is obeyed. The method is quite reliable. Sensitivity  $0.07 \gamma \text{ Ti per cm}^2$  ( $pD=7.16$ ).

Disodium 1:2 dihydroxybenzene 3:5 disulphonate ('tiron') gives a lemon yellow colouration with  $\text{Ti}^{++++}$  in pH range 4.3 to 9.6, having a maximum absorption at 410  $m\mu$ . Beer's law holds good up to 4 p.p.m. Ti and measurements can be made in presence of iron (III) at pH 4.7 by reducing with sodium dithionite. The method is not only reliable but very sensitive also. Sensitivity  $0.003 \gamma \text{ Ti per cm}^2$  ( $pD=8.52$ ).

The orange-red colour produced by  $\text{Ti}^{++++}$  at pH 2.7 to 4.6, in presence of an aqueous solution of chromotropic acid (disodium 1:8 dihydroxy naphthalene 3:6 disulphonate) has been the basis of estimating the element colorimetrically at 470  $m\mu$ , where Beer's law is obeyed up to 4 p.p.m. Ti. The colour varies with the acid concentrations. Sensitivity  $0.004 \gamma \text{ Ti per cm}^2$  ( $pD=8.4$ ).

Suphosalicic acid which gives a yellow colour with  $\text{Ti}^{++++}$  in the pH range 3.2 to 4.9 serves as a very good and sensitive colorimetric reagent for the same at 365 or 370  $m\mu$ . Beer's law is obeyed. Interference of ferric iron can be eliminated by using thioglycollic acid. Sensitivity  $0.003 \gamma \text{ Ti per cm}^2$  ( $pD=8.52$ ).

Gallic acid in presence of sodium acetate develops a reddish-brown colour (pH 4.5 to 5.2), which may be measured at 365 or 400  $m\mu$ , where Beer's law holds good. The method is sensitive, but has the disadvantage of being interfered with by too many ions. Sensitivity  $0.003 \gamma \text{ Ti per cm}^2$  ( $pD=8.52$ ).

Ti<sup>+</sup> can be estimated colorimetrically using salicylic acid in concentrated sulphuric acid (above 80%). The blood-red colour obeys Beer's law at 425  $m\mu$ . Sensitivity  $0.014 \gamma \text{ Ti per cm}^2$  ( $pD=7.85$ ).

Thymol under similar conditions as those of salicylic acid gives a red colouration. Beer's law holds good up to 20 p.p.m. Ti at 425  $m\mu$ . Sensitivity  $0.01 \gamma \text{ Ti per cm}^2$  ( $pD=8$ ).

A 2% alcoholic solution of salicyl hydroxamic acid in 6 to 11N sulphuric acid also serves as a colorimetric reagent for  $\text{Ti}^{++++}$ . The colour formed is yellow and measurements are to be made at 395  $m\mu$  where Beer's law is obeyed. Sensitivity  $0.01 \gamma \text{ Ti per cm}^2$  ( $pD=8$ ).

#### 5. On the Separation of Inorganic Anions by Chalk Crayon Chromatography.

BINAYENDRA NATH SEN, Burdwan.

The possibilities of Chalk Crayons as short adsorbent columns in the chromatographic separation of ions have been brought out in a previous communication



(Sen, B. N., Zeit Anorg. Chem., 273, 183, 1953; 276, 1954) and about a dozen inorganic cations groups have been separated on chalk crayon supports (ibid). The method is being extended to the separation of inorganic anions. Successful separation of  $\text{PO}_4^{-3}-\text{HPO}_3^{-2}$ ;  $\text{AsO}_4^{-3}-\text{AsO}_3^{-3}$ ;  $\text{AsO}_4^{-3}-\text{HPO}_3^{-2}$ ;  $\text{AsO}_3^{-3}-\text{HPO}_3^{-2}$ ;  $\text{S}_2\text{O}_3^{-2}$ ;  $\text{CNS}^-$ ;  $\text{Fe}(\text{CN})_6^{-3}-\text{CNS}^-$ ;  $\text{Fe}(\text{CN})_6^{-4}-\text{CNS}^-$ ;  $\text{Fe}(\text{CN})_6^{-3}-\text{Fe}(\text{CN})_6^{-3}$  have been effected.

#### 6. Two-dimensional paper Chromatography of some of the Organic Acids including those belonging to Krebs cycle.

D. P. BURMA, Calcutta.

The chromatographic behaviour of a number of organic acids in form of their sodium salts with different solvent combinations is studied. The organic acids on the developed chromatogram are detected by spraying with Zinc uranyl acetate solution when the sodium salts fluoresce under ultraviolet light.  $R_F$  values so obtained indicate that very little success can be achieved in separating them by the one-dimensional procedure.

In fact most of the acids belonging to Krebs cycle and some other organic acids as oxalic, tartaric etc. are successfully separated by means of a two-dimensional procedure with phenol-water as the first solvent and benzylalcohol-acetic acid-water (25:5:6.5) as the second, the same two solvent combinations which have been extensively applied by the author in the two-dimensional separation of amino acids. A two-dimensional chromatogram is presented.

#### 7. Estimation of Silica.

ANIL KUMAR MAJUMDAR and SIDDHESHWAR BANERJEE.

5:6-Benzoquinoline and 8-Hydroxyquinoline have been used as organic bases for the quantitative precipitation of silica as silicomolybdic salts of the bases under suitable conditions of acidity. The salts being stable and non-hygroscopic may be directly weighed after drying at 110-150°C or alternatively may be ignited at 550°C with free access of air to silico-molybdic anhydride.

#### 8. Thiocyanometric Titrations Catalysed with Mercuric Salts.

M. N. GOSWAMI and S. K. CHAKRAVARTI, Calcutta.

Mercuric chloride has been found to catalyse the addition of thiocyanogen to oils containing unsaturation and greatly inhibits the polymerisation of the thiocyanogen in glacial acetic acid.

A 5-hour mercuric chloride catalysed thiocyanogen value is equivalent to a 24-hour normal thiocyanogen value and the addition is completely free from polymerisation, when the reaction is catalysed by a 2.5% solution of mercuric chloride in dry acetic acid.

#### 9. Thioammeline as an Analytical Reagent.

DEBABRATA BANDYOPADHAYAY, Calcutta.

The precipitation reactions of thioammeline,  $\text{C}_3\text{N}_5\text{H}_5\text{S}$ , with various metallic ions has been investigated. It has been found that this organic reagent, which is a thioamide, gives coloured precipitates with most of the metals of the hydrogen sulphide group: in acid solution with copper (yellow), palladium (light-yellow), mercury<sup>II</sup> (white), silver (white) and bismuth (light-yellow, from  $\text{BiCl}_3$ ); while in alkaline medium with cadmium (yellow), nickel (yellow), cobalt (brick-red), ferric (light-buff), manganese (white) and zinc (white). Precipitation of copper, in presence

of excess of thioammeline, is complete at a pH as low as 2.4, in a 0.001 M solution of copperII salt. The precipitate, after washing with water can be decomposed by nitric acid and copper estimated iodometrically as usual. The precipitation of copper in acid solution, under controlled pH, has been made use of for its separation from excess of zinc or nickel, and twice its own amount of cadmium. For larger amounts of cadmium reprecipitation is necessary. In the filtrate the other metals can be estimated as usual after decomposing organic matter with sulphuric acid. The results are quite satisfactory and the reagent can be easily prepared (Rallike, Ber., 1885, 18, 3102) in a pure state.

#### 10. Ortho-Hydroxyacetophenone Oxime as an Analytical Reagent for the Colorimetric Estimation of Iron and Uranium.

SAILENDRA NATH PODDAR, Calcutta.

The present paper introduces O-hydroxy acetophenone oxime as a colorimetric reagent for the estimation of iron and uranium. All the colour measurements were made in Unicam SP. 600 spectrophotometer using 1 cm glass cells and the pH measurements were in the Cambridge Bench type pH meter. All the reagents used were chemically pure of G.R. quality.

The optical densities of the coloured solutions of iron and uranium increase continuously towards the shorter wavelengths; the reagent also shows strong absorption near the ultra-violet, but the absorption is almost negligible at about 420 m $\mu$ ; hence measurements were made at this wavelength. Uranium gave a yellow colour which was maximum at the pH range 9.7 to 11.1, whereas iron gave an orange-yellow colour which was maximum at pH range 5.0 to 8.0. Iron also gave a purple colouration at lower pH (2 to 3). The colour intensities were fairly high permitting the estimation of very small amounts of iron and uranium. Sensitivities were found to be 0.1  $\gamma$  U per cm<sup>2</sup> and 0.01  $\gamma$  Fe per cm<sup>2</sup>. Both the colour systems for iron and uranium obeyed Beer's law over a wide range of concentrations of the metallic ions under consideration and the colours were found to be stable for a long period of time. Temperatures (20° to 60° C) were found to have no effect on the colours. An excess of the reagent equivalent to about 40–60 times that of the metal ions was required for the full development of the colours. Common ions like those of alkali metals, alkaline earth metals, F<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, I<sup>-</sup>, NO<sub>3</sub><sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, acetate, formate, borate, salicylate, citrate, tartarate, carbonate, oxalate, tungstate, molybdate, and nitrite do not interfere in the estimation of uranium, but the presence of copper, nickel, palladium, lead, mercury, manganese, iron (both in ferrous and ferric state), phosphate and vanadate ions interfere. In the estimation of iron, the heavy metal ions like those of copper, nickel, palladium, lead, mercury and ferrous iron, besides citrate, oxalate, tungstate and vanadate ions were found to interfere.

#### 11. Estimation of Cobalt by Benzimidazole.

S. P. GHOSH and H. M. GHOSH, Patna.

A new method for the estimation of cobalt by benzimidazole has been established. Cobalt is precipitated as Co (C<sub>7</sub>N<sub>2</sub>H<sub>3</sub>)<sub>2</sub> by aqueous benzimidazole at pH 10 with ammonia. The precipitate is dried at 140° C and directly weighed. The compound contains 20.12% cobalt. Cobalt can be separated from barium and calcium by this method.

#### 12. Amperometric Estimation of Lead.

BALDEV KHOSLA, Delhi.

Quantitative estimation of small quantities of lead was carried out by amperometric titration of Pb (NO<sub>3</sub>)<sub>2</sub> soln. using K<sub>4</sub>Fe (CN)<sub>6</sub> and Na<sub>2</sub>HPO<sub>4</sub> as titrants. A



manual polarograph constructed for the purpose was employed. The method enabled determination of  $Pb^{++}$  within 1 per cent error; presence of  $Ca^{++}$ ,  $Ba^{++}$ ,  $Mg^{++}$ , etc. did not interfere.

### **13. Volumetric method for the Determination of Zirconium.**

M. R. VERMA AND S. D. PAUL.

Mandelic acid and its derivatives are known to be specific reagents for precipitation of zirconium. The tetra-halo mandelate precipitates zirconium quantitatively and is soluble in ammonium salts. A method has been developed for ceratometric estimation of the tetra-halomandelates and this forms the basis for determination of zirconium.

### **14. Estimation of Arsenic or Antimony in presence of Copper.**

M. R. VERMA and Y. P. SINGH.

In the presence of alkali citrate, copper ions form a complex permitting an iodimetric determination of arsenic or antimony. By lowering the pH value, copper complex breaks down and the iodine equivalent of the same may be determined. This method is applicable to assay of Paris Green.

### **15. Volumetric method for Iodimetric Determination of Vanadium.**

M. R. VERMA and V. M. BHUCHAR.

Pentavalent vanadium is reduced quantitatively to tetravalent state by boiling with alkali citrate, which may be quantitatively determined iodimetrically. This method is comparable to the sulphur dioxide or ferrous sulphate methods in accuracy and reproducibility and is useful for determination of copper and vanadium, when present together.

### **16. Two Dimensional paper Chromatographic method for Detection of Phenols in Bitumen.**

M. R. VERMA and RAMJI DASS.

Phenols are separated from bitumen in a direction of the plane of the paper with alcohol; dye is prepared in situ and elution carried out in a direction right angles to the former by using methyl-ethyl ketone as the eluting agent. Bands characteristic of phenols separate out. The results are of application in the analysis of cable compositions.

### **17. Estimation of Boric acid in Nickel-plating Baths.**

M. R. VERMA and K. C. AGRAWAL.

If an alkali oxalate is used for complexing Nickel salts, boric acid becomes available for determination alkalimetrically. This procedure simplifies determination of this important buffering agent in electro-plating practice.

### **18. Spot-test method for the detection of cadmium in presence of copper, tin and lead.**

M. R. VERMA and S. D. PAUL.

One drop of the solution (0.05 ml.) is placed in the centre of filter paper, and the paper made alkaline with ammonia. It is exposed to  $H_2S$  and the paper

irrigated with dilute solution of potassium cyanide. A clear yellow ring indicates the presence of cadmium. Quantities of cadmium as low as 5 or 0.1% by weight of total can be easily detected. This method is applicable to the analysis of bearing and other alloys.

### 19. Investigations in Viscosity of Milks. Part VII—Viscosity of Milk and Adulteration (by added water).

K. K. DOLE and P. S. KULKARNI, Poona.

The viscosity of whole milk decreases on dilution with water and with 25 per cent. dilution by volume. The decrease is about 20-22 per cent. of the initial viscosity in buffalo milk and about 15-18 per cent. in cow milk. The decrease is, however, very sharp in the first stage of dilution i.e. with 5 per cent. added water. It is 7.6 per cent. in buffalo milk and 5.9 per cent. in cow milk. Since the viscosity of both buffalo and cow milk is found to vary within sufficiently wide ranges, this decrease in viscosity due to dilution (with water) will not easily enable the analyst to label a sample as "adulterated".

The importance of the ratios  $K$  and  $K'$ , i.e. the relationships which the viscosity constant bears to the contents of total solids and solids-not-fat respectively, is due to the fact that both of them are nearly constant for a particular milk. Moreover, the contents of solids-not-fat in a milk are constant, though the contents of fat in it may vary. Hence by applying the ratio  $K'$  to the viscosity constant of a sample, its contents of solids-not-fat can be immediately calculated, and if they are found below the minimum standard, the sample can safely be treated as adulterated.

The observations on the market samples of milk show that they are invariably adulterated, when seen in the light of those on the genuine ones. The percentage of added water, as calculated by either of the formulae,

$$(i) \% \text{ Added water} = \frac{d \text{ T.S.}}{\text{T.S.}} \times 100 \text{ or } (ii) \% \text{ Added water} = \frac{d \text{ S.N.F.}}{\text{S.N.F.}} \times 100,$$

is the same, thus showing that the ratios  $K$  and  $K'$  can be applied for estimating the added water, with an equal accuracy. If thoroughly investigated, viscosity of milk may prove a very useful tool in the hands of the Public Analyst.

### 20. Determination of Copper in Colloidal Preparation.

SUKHAMOY BHATTACHARYA, Calcutta.

Colloidal copper for pharmaceutical preparations contains besides copper, various organic matter derived from egg albumen, dextrin and glucose. In assaying such preparation the first step is to remove the organic matters for which two methods are available. In the first method, wet samples are dried on steam bath or in oven and then ignited till the ash is free from carbon. In the second method the organic matter is removed by boiling with a mixture of nitric acid and sulfuric acid for a number of times till the final solution is clear and colourless.

The wet oxidation method if applied to the colloidal copper preparation which contains no other metal except copper takes a long time for analysis. The ashing method suffers from the disadvantage that it stains the crucible to a considerable extent. For a rapid method of determination of copper an improved process of destroying the organic matter by direct ashing of the solution soaked in strips of ashless filter paper has been found out. The rest of the process of assay lies in determining copper iodimetrically in the usual way.



**21. Chemical Assay of Antibiotics : (a) A Colorimetric determination of Streptomycin, Dihydrostreptomycin, their mixtures and derivatives in Medical Preparations.**

H. K. BANERJEE, Calcutta.

A method of quantitative estimation of streptomycin, dihydrostreptomycin from various mixtures and combinations had been developed in this Laboratory based on Voges-Poroskauer reaction modified by Harden and Norris and by Barrit.

The colorimetric method with certain modifications had been perfected, after studying the optimum conditions of time, temperature, concentration of reagent mixtures and the wavelengths of maximum absorption.

$\lambda$  max ranged from 500 m $\mu$  to 530 m $\mu$  and with the combination and order of reagents added the maximum was 525 m $\mu$ . Large number of the antibiotic samples were tested by this method and compared with the result obtained microbiologically with *Bacillus subtilis*. The agreement was satisfactory, the maximum deviation being within  $\pm 3$  per cent.

**22. Estimation of Diazonium Salts.**

K. Z. PATIL, Kharagpur.

The diazonium salts like chloride, bromide and sulphate were estimated by adding an excess of titanous chloride or sulphate to a well-cooled solution of diazonium salt. The excess of titanous salt remaining unreacted was determined by titration, against standard ferric ammonium sulphate solution with ammonium thiocyanate as an external indicator. This method is recommended for the estimation of azo compounds but was found to be equally useful for the estimation of diazonium salts from aniline, 1- and 2-naphthylamine and sulphanilamide. The results are checked by the established methods like gasometric method and on alkaline 2-naphthol coupling method.

**23. Estimation of Total Tocopherols in Blood.**

P. P. NAIR and N. G. MAGAR, Bombay.

A new colour reaction between Phosphomolybdic acid and Tocopherol (P.M.A.—Tocopherol colour reaction) has been suitably adapted for tocopherol assay in blood plasma or serum. The method consists of a preliminary precipitation of proteins from plasma or serum by absolute alcohol, followed by extraction of tocopherol with pure Xylene.

An aliquot of the Xylene supernatant is treated with n-propyl alcohol and phosphomolybdic acid reagent and maintained at 30°C for 30 minutes. The intensity of the colour developed is measured at 725 m $\mu$  and compared with a calibration curve obtained with pure  $\alpha$ -tocopherol. The method was found to be highly sensitive, specific and simple.

## INORGANIC CHEMISTRY

**24. Carbides of Titanium.**

D. P. KHARKAR, C. C. PATEL and M. R. A. RAO, Bangalore.

A method has been evolved for the preparation of the carbides of titanium at as low a temperature as 800°C. by taking advantage of the reaction between titanium tetrachloride and ethylene. The reaction was carried out in a quartz tube at 800°C. Black shining flakes were obtained in the reaction tube which

examination by x-ray diffraction patterns showed the formation of titanium carbide (TiC) together with two other interstitial compounds having the composition  $\text{TiC}_x$  where the value of  $x$  varied from 2 to 4.

### 5. Peroxalates of Titanium.

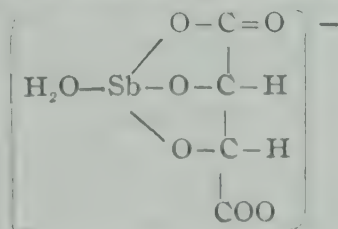
D. P. KHARKAR and C. C. PATEL, Bangalore.

When an aqueous suspension of pertitanic acid was added to the aqueous solution of oxalic acid, the colour of the mixture changed to red which on concentration gave rise to a new compound having the formula  $\text{Ti}_2\text{O}(\text{C}_2\text{O}_4)_2 \cdot 10\text{H}_2\text{O}$ . The absorption spectrum, the vapour pressure measurements and the conductivity data of the compound confirm the above composition.

### 6. Tartarate Complex of Trivalent Antimony—Part I.

K. C. SAMANTORA, D. V. RAMAN RAO and S. PANI, Cuttack.

The variation of pH on neutralisation of tartaric acid containing small amount of antimony chloride under identical conditions were studied. Two equivalents of acid per atom of antimony were observed to be liberated. It is concluded that both the hydroxyl groups of tartaric acid take part in the reaction for the formation of antimonyl tartarate ion



### 27. The Study of Lactate Complex of Trivalent Antimony by Glass Electrode.

G. PATRA and S. PANI, Cuttack.

Lactate complexes of trivalent antimony are investigated by pH titration method. Two complexes containing respectively one and two lactate ligands per antimony atom exist. The equilibrium constant of the reaction for the formation of the second complex containing two lactate ligands is 0.54.

### 28. Thermal Decomposition of Chromic Trioxide.

V. S. RAMACHANDRAN and S. K. BHATTACHARYYA, Kharagpur.

Various methods have been adopted to study the products obtained by the thermal decomposition of chromic trioxide but the conclusions drawn by different workers seem to have wide disparity. With a view to throw more light on this decomposition course, the differential thermal analysis of analar chromic trioxide ( $\text{CrO}_3$ ) was studied both in an atmosphere of air and nitrogen. From the results the following conclusions are drawn:

The oxide exhibits a low temperature endothermal peak at  $135^\circ\text{C}$ , followed by another endothermal peak at  $215^\circ\text{C}$ . The former is probably due to the expulsion of adsorbed water and the latter to the fusion of the oxide. The above results have not been reported from either the x-ray diffraction analysis or magnetic susceptibility measurements.

An exothermic peak of large magnitude is obtained at  $325^\circ\text{C}$  which may be due to the formation of a crystalline mixture of  $\text{Cr}_2\text{O}_3$  and  $\text{Cr}_3\text{O}_8$ .

The endothermal peak obtained at  $470^\circ\text{C}$  is probably due to the formation of  $\text{Cr}_2\text{O}_3$ . This is in agreement with the results obtained by x-ray diffraction studies reported in literature.



**29. Complex Compounds of Silver (II) with p-Phenetyl Biguanide.**

S. P. GHOSH and A. K. BANERJEE, Patna.

Two complex salts of bivalent silver have been prepared by the oxidation of silver sulphate with potassium persulphate in the presence of p-phenetyl biguanide sulphate, viz.  $[\text{Ag (II) (C}_{10}\text{N}_5\text{H}_{15}\text{O)}_2]\text{SO}_4 \cdot 2\text{H}_2\text{O}$  and  $[\text{Ag (II) (C}_{10}\text{N}_5\text{H}_{15}\text{O)}_2](\text{NO}_3)_2 \cdot \text{H}_2\text{O}$ . Both the compounds were obtained in two different modifications, viz. brownish yellow and black. This is explained on the grounds that the four co-ordinated silver complexes will have a planar configuration with d-s-p hybrid bonds. As the coordinating molecule is unsymmetrical "cis-trans" isomerism might be exhibited. All the compounds were paramagnetic with the magnetic moments varying from 1.71 to 1.81 Bohr magneton. The value is approximately equal to the theoretically calculated value for one unpaired electron.

**30. Complex Compounds of Biguanide with Bivalent Cobalt.**

ASIT KUMAR RAY, Calcutta.

The present paper deals with the preparation and properties of a number of biguanide complexes of cobalt (II). The yellow cobaltous complexes of dimethyl and diethyl biguanide are found to be very unstable and difficult to isolate in the pure state. On account of their great instability they could not however be isolated in Kapsenburg's filtration apparatus in presence of pure hydrogen, nitrogen or coal gas. On the other hand, the brick-red cobaltous-parachlorophenyl-isopropyl-biguanide complex was rather stable resembling the cobaltous phenyl-biguanide parasulphonic acid, described by Ray & Chakravarty (J.I.C.S., 25, 563, 1948), and like the cobaltous ethylene dibiguanide sulphate. The cobaltic complexes of dimethyl, diethyl and parachlorophenyl-isopropyl-biguanide are deep red crystalline compounds highly soluble in water and alcohol.

**31. Cis-trans Isomerism of Copper Biguanide Complexes.**

ASIT KUMAR RAY, Calcutta.

The paper describes that in the study of copper complexes of paludrine there are indications that two varieties of copper paludrine complexes, red and blue, are formed and they are found to possess the same composition by analysis. These two modifications may be represented as cis-trans isomers of a planar penetration coomplex with  $\text{dsp}_2$  hybrid bonds. This type of isomerism bears a close analogy to that shown by the two varieties of copper N-diethyl-biguanide (Ray and Ghosh, J.I.C.S., 26, 144, 1949) by two varieties of copper-phenyl-biguanide-p-sulphonic acid (Ray and Siddhanta, J.I.C.S., 20, 250, 1943), as well as by naphthaldehyde methylimine-copper (Pfeiffer and Glasser, J. Prakt. Chem., 153, 265, 1939) sulphonic acid (Green blue violet) nickel phenyl biguanide (yellow and red).

The alcoholic solutions of equimolecular amounts of cis-trans modifications of copper diethyl biguanide, copper-paludrine did not show any difference in the absorption in the visible region in the spectrophotometer. But the infra-red spectra of the cis-trans isomers of copper-diethyl biguanide, copper Paludrine and copper-phenyl biguanide-p-sulphonic acid definitely establishes the following:-

Copper-Paludrine (Blue variety) Cis isomer.

Copper-Paludrine (Red variety) Trans isomer.

Copper-diethylbiguanide (Red variety) Cis isomer.

Copper-diethylbiguanide (Blue variety) Trans isomer.

Copper-phenyl biguanide-p-sulphonic acid (Violet variety) Cis isomer.

Copper-phenyl biguanide-p-sulphonic acid (Green variety) Trans isomer.

**32. Stability of Copper and Nickel Biguanide Complexes.**

ASIT KUMAR RAY, Calcutta.

Ray and Das Sarma prepared a large number of complex copper and nickel biguanide, dibiguanide complexes in the pure state and the decomposition of these complexes in aqueous acid solution were studied. It was found that for systems, where the stabilities are of inferior order, the equivalent amounts of ligand present in the complex are incapable of keeping the metal ions in aqueous solution with the result that a separation of metallic hydroxides occurred. The evaluation of the stability of such systems was, therefore, not possible.

The present paper describes the investigation of the problem in the reverse way viz. as formation reaction. Using higher concentrations of the ligands than that corresponds to the saturation of metal ions in terms of Werner's maximal co-ordination e.g. biguanide equivalent to 4-6 fold the concentration of the metal ions was found to be necessary. A number of systems using highly substituted biguanides was carried out in water alcohol mixed solvent due to their relative insolubility in water. From these the instability constants of these complexes have been calculated which support the order of the instability constants of the complexes as shown by Ray and co-workers.

The order for Copper complexes is as follows:

Copper ethylene dibiguanide < copper biguanide < copper methyl biguanide < copper ethyl-biguanide < copper-phenyl biguanide < copper Paludrine < copper dimethyl biguanide < copper diethyl biguanide.

And for nickel complexes:

Nickel ethylene dibiguanide < Nickel biguanide < Nickel methyl biguanide < Nickel-phenyl biguanide < Nickel Paludrine < Nickel dimethyl biguanide.

**33. Hydrolysis of Phosphorous Trichloride and Preparation of Phosphorous Tetritoxide.**

P. C. SINHA, K. K. CHATTERJEE and S. N. SANYAL, Patna.

By mixing  $\text{PCl}_3$  with water, a very small quantity of a yellow solid was obtained. The phosphorus content of this substance was determined and was found to be 88.14%. A similar compound was also obtained by Michaelis and Pitsch (Annalen, 1900, 310, 45) by the action of Acetic Anhydride upon Hypophosphorous Acid. The chemical properties of the yellow substance obtained by us and those by Michaelis and Pitsch are similar. The authors are of opinion that this substance is  $\text{P}_4\text{O}_6$ ; this is further corroborated by its reaction with standard  $\text{KMnO}_4$  and Iodine solutions.

**34. The Potentiometric Study of Metal Ammines.**

S. K. K. JATKAR and K. A. KHASGIWALE, Poona.

The existence of several complex metal ammines reported in literature, has been now established in greater details by potentiometric study of ammines of Ag, Cu, Au, Ni, Pb, Zn, Cr and Pt, using the electrode system, Pt/solution/Sat:KCl/Sat:KCl  $\text{Hg}_2\text{Cl}_2/\text{Hg}$ . The study has been carried out by continuous variation method, with two different concentrations of ammonia, and both direct and reverse titrations have been carried out. The  $\Delta_t$ /mean cc curves, show presence of lower metal: ammonia ratios up to 1/6, as well as show presence of higher ratios, such as 1:8, 1:27, etc. The curves also show breaks at odd ratios such as 1:5, 1:1.5, 1:2.5, etc., indicating an association of two metal ions. The occurrence of high metal: ammonia ratios has been explained on the basis of electrostatic attraction.



**35. Studies of the Complex Metal Cyanides in Solution.**

S. K. K. JATKAR and S. M. Jogdeo, Poona.

About thirty elements are known to form complex cyanides. In the past, these complex salts have been isolated in the solid state and their properties have been studied. The conclusions of the analytical methods have been supported by the physico-chemical methods.

In the present work the formation of the complex cyanides (Cu, Ag, Au, Pt, Pd, Zn, Cd, Hg, Fe, Co, Ni, Cr) in solution has been studied by both direct and reverse potentiometric titrations of the solutions of metal salts with potassium cyanide, using the electrode system,

Pt or metal amalgam	solution	Sat KCl or KNO <sub>3</sub>	Sat KCl Hg <sub>2</sub> Cl <sub>2</sub> /Hg
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by the continuous variation method. The results indicate the stepwise formation of the complexes due to replacement of the water molecules co-ordinated around the central ion.

**36. Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. V. The System: BaBr<sub>2</sub>-CO(NH<sub>2</sub>)<sub>2</sub>-H<sub>2</sub>O (Conductivity and Viscosity).**

C. S. PANDE and M. P. BHATNAGAR, Lucknow.

In our previous communications (Pande & Bhatnagar: J.I.C.S., 1954, 31, 5, 402 & 406) the existence of four probable complex compounds has been established in the Barium Chloride-Urea-Water system. The investigation was further extended to the system: Barium bromide-urea-water.

The Monovariation Method (Nayar and Pande: Proc. Ind. Acad. Sci., 1948, 274, 286) has been followed in the preparation of the solutions and in the investigation of the physico-chemical properties. Conductivity and viscosity measurements of the solutions revealed the existence of four analogous complex compounds viz.,

- |   |  |
|---|--|
| (1) 2BaBr <sub>2</sub> .CO(NH <sub>2</sub> ) <sub>2</sub> ,   | (2) BaBr <sub>2</sub> .CO(NH <sub>2</sub> ) <sub>2</sub> , |
| (3) BaBr <sub>2</sub> .2CO(NH <sub>2</sub> ) <sub>2</sub> and | (4) BaBr <sub>2</sub> .4CO(NH <sub>2</sub> ) <sub>2</sub>  |

in this system also. The results are brought out more prominent by plotting  $\Delta x/c.c.$  of the properties studied.

**37. Formation of Complex Compounds between Urea and Alkaline Earth Halides—Pt. VI. The System: BaBr<sub>2</sub>-CO(NH<sub>2</sub>)<sub>2</sub>-H<sub>2</sub>O (Surface Tension and Refractive Index).**

M. P. BHATNAGAR and C. S. PANDE, Lucknow.

Measurements of conductivity and viscosity with the system: Barium Bromide-Urea-Water revealed the existence of four complex compounds, already reported (Z. physikal. Chemie, 1954, 203, 3/4, July issue). In order to obtain an additional confirmation about the existence of the above complexes in solution, surface tension and refractive index were also studied. Traube's stalagmometer method and Critical angle Refractometer were used for surface tension and refractive index measurements, respectively (Findlay: Pract. Phys. Chem.).

On plotting the values against the variant, kinks were obtained at points corresponding to the compounds reported in Part V of this series (loc. cit.). When such widely different properties, like conductivity, viscosity, surface tension and refractive index lead to the same conclusions, there is no question about the genuineness of the phenomenon and the existence of the compounds stated above.

**8. Formation of Complex Compounds between Urea and Alkaline Earth Halides—  
Pt. VII. The System:  $\text{BaBr}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$  (Rheochor, Parachor and Molecular Refraction).**

C. S. PANDE and M. P. BHATNAGAR, Lucknow.

In the preceding parts of this series, enough experimental evidence has been adduced for the existence of four complex compounds between barium bromide and carbamide in solution. The existence of these complexes was further confirmed by studying Rheochor, Parachor and Molecular refraction of the solution and the solute, calculated on the basis of the original properties, viz., relative viscosity, surface tension and refractive index, respectively. A mere graphical representation of these values indicates similar results. The breaks occur at stoichiometric ratios corresponding to the complexes: (i)  $2\text{BaBr}_2\text{.CO(NH}_2)_2$ , (ii)  $\text{BaBr}_2\text{.CO(NH}_2)_2$ , (iii)  $\text{BaBr}_2\text{.2CO(NH}_2)_2$  and (iv)  $\text{BaBr}_2\text{.4CO(NH}_2)_2$ .

**39. Formation of Complex Compounds between Urea and Alkaline Earth Halides—  
Pt. VIII. The System:  $\text{BaI}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$  (Conductivity and Viscosity).**

C. S. PANDE and M. P. BHATNAGAR, Lucknow.

Specific conductivity and relative viscosity measurements of the system: Barium Iodide-Urea-Water reveal the existence of five complex compounds having the formulae:

- (1)  $2\text{BaI}_2\text{.CO(NH}_2)_2$ ,
- (2)  $\text{BaI}_2\text{.CO(NH}_2)_2$ ,
- (3)  $\text{BaI}_2\text{.2CO(NH}_2)_2$ ,
- (4)  $\text{BaI}_2\text{.3CO(NH}_2)_2$  and
- (5)  $\text{BaI}_2\text{.4CO(NH}_2)_2$ .

Monovariation Method was employed in the preparation of the solutions and investigation of the physico-chemical properties. A set of thirty-four mixed solutions was prepared in such a way that the concentration of barium iodide was kept constant while that of urea varied systematically.

Kohlrausch's meter-bridge method and Ostwald's viscometer method were employed in the investigation of the above properties. When values of viscosity and conductivity were plotted against the concentration of urea, curves were obtained with five specific breaks. The kinks occur at exact stoichiometric ratios of concentrations corresponding to the compounds mentioned above.

**40. Formation of Complex Compounds between Urea and Alkaline Earth Halides—  
Pt. IX. The System:  $\text{BaI}_2\text{-CO(NH}_2)_2\text{-H}_2\text{O}$  (Refractive Index and Freezing Point).**

M. P. BHATNAGAR and C. S. PANDE, Lucknow.

Conductivity of viscosity measurements of the system: barium iodide-urea-water, revealed the existence of five compounds in solution, namely:

- (i)  $2\text{BaI}_2\text{.CO(NH}_2)_2$ ,
- (ii)  $\text{BaI}_2\text{.CO(NH}_2)_2$ ,
- (iii)  $\text{BaI}_2\text{.2CO(NH}_2)_2$ ,
- (iv)  $\text{BaI}_2\text{.3CO(NH}_2)_2$  and
- (v)  $\text{BaI}_2\text{.4CO(NH}_2)_2$ .

In continuation of our previous work described in Pts. V-VIII (loc. cit.), we report the results obtained by the measurements refractive index and depression in



freezing point. These results also indicate the formation of the above mentioned compounds. When such widely differing properties like conductivity, depression in freezing point (ionic), viscosity (a bulk property) and refractive index (optical) indicate the same results, there is no reason to doubt the existence of these compounds.

## PHYSICAL CHEMISTRY

### 41. An Electrolytic Study of Aqueous Lead Formate Solutions.

A. N. KAPPANNA and A. S. DEWAGAN, Nagpur.

An electrolytic study of aqueous lead formate solutions has been made. The formate ion does not seem to exert any depolarising effect on the formation of lead peroxide on the anode. A quantitative study shows that 2 Faradays of current are needed for the deposition of one molecule of lead peroxide.

Anode discharge potential in lead formate electrolysis indicates the discharge of formate ion as the primary anodic reaction. A mechanism has been suggested for the formation of lead peroxide by the interaction of the liberated formate radicals on the anode with bivalent lead ion and water.

### 42. The Thermal Decomposition of Silver Nitrite.

T. M. OZA, V. T. OZA and R. H. THAKER, Ahmedabad.

The decomposition of silver nitrite as  $\text{AgNO}_2 \rightarrow \text{Ag} + \text{NO}_2$ , in the primary stage, is shown to proceed through the intermediate fast reaction  $2\text{AgNO}_2 \rightleftharpoons \text{Ag}_2\text{O} + \text{NO} + \text{NO}_2$ . Nitrate is formed by the action of nitrogen dioxide on the nitrite but some nitrate at the start is formed also by the oxidation of the nitrite by silver oxide as  $\text{AgNO}_2 + \text{Ag}_2\text{O} \rightarrow \text{AgNO}_3 + 2\text{Ag}$ .

The reaction  $\text{AgNO}_2 + \text{NO} \rightarrow \text{AgNO}_2 + \frac{1}{2}\text{N}_2$  (the kind of reaction in other nitrites, responsible for the production of nitrogen) is absent as the reaction  $\text{AgNO}_2 + \text{NO} \rightleftharpoons \text{AgNO}_2 + \text{NO}_2$  is very prominent.

There is little evidence, at present, for the occurrence of the reaction  $\text{Ag}_2\text{O} + 2\text{NO}_2 \rightarrow \text{AgNO}_2 + \text{AgNO}_3$ .

### 43. On Thermoionic Potential. A Physico-chemical Theory of Thermoionic Effect on the basis of parachoric strain.

BINAYENDRA NATH SEN, Burdwan.

Assuming that the atom in the solid state is rendered capable of emitting electrons when it has been brought from the actual state to what has been propounded as the 'critical state' of strain, the work factor being controlled ultimately by the mean atomic volumes in the two states, a formula has been proposed for the evaluation of thermoionic potential.

$$\Phi = K \ln \left[ Y' - \frac{1}{4} \cdot \frac{P}{V} \right]$$

Where K is a constant, Y', the 'critical surface tension'; P, the parachor and V, the atomic volume.

The formula bears out values in comparative agreement with the experimental ones in cases of about a dozen elements.

#### 4. Studies in Electrodes of the Third Kind.

J. N. SAHAY, Ranchi.

Experimental results are given for the activity coefficient of Calcium Chloride deduced from the E.M.F. measurements of the cell :

$\text{Zn}/\text{ZnCl}_2\text{O}_4, \text{CaCl}_2\text{O}_4/\text{CaCl}_2(m)/\text{AgCl}-\text{Ag}$  in which  $m$  was varied from 0.001  $m$  to 0.05  $m$ . It has been observed that in dilute solution under controlled condition Zinc in contact with Zinc Oxalate, Calcium Oxalate and a solution of Calcium Chloride acts as a Calcium ion electrode. Results obtained by using the electrode  $\text{Hg}/\text{Hg}_2\text{C}_2\text{O}_4-\text{CaC}_2\text{O}_4/\text{Ca}^{++}$  was found to be of doubtful accuracy unless protected by cellophane membrane. Satisfactory equilibrium was reached within an hour.

The values obtained earlier by using cell of the type :  $\text{Pb}-\text{Hg}/\text{PbC}_2\text{O}_4, \text{CaC}_2\text{O}_4/\text{AgCl}-\text{Ag}$  have been found to be in fair agreement with those of the present investigations.

#### 15. The Study of $\frac{\text{Na}^+}{\text{K}^+}$ reversibility on clay membrane electrodes.

SAROJ KUMAR BOSE, Calcutta.

Thin clay membranes suitably prepared acquire the property of registering ionic activities in contact with electrolytic solutions. Electrochemically, it is expedient to consider them as ion-reversible electrodes, rather than ion-permeable. On the basis of the latter hypothesis the membranes are characterised by "mobility ratios" and on the former by the difference in standard free energies of the reactions occurring on the electrodes surfaces. Thus, the observed e.m.f.,  $E$ , of a cell arrangement consisting of the membrane separating two solutions of  $\text{NaCl}$  and  $\text{KCl}$  having known ionic activities,  $a_{\text{Na}}$  and  $a_{\text{K}}$ , becomes equal to

$$\frac{RT}{F} \ln \frac{a_{\text{K}}}{a_{\text{Na}}} \cdot \frac{U_{\text{K}}}{U_{\text{Na}}} \text{ or, } E_{\text{Na,K}}^0 + \frac{RT}{F} \ln \frac{a_{\text{K}}}{a_{\text{Na}}}. \text{ The mobility ratio, } \frac{U_{\text{K}}}{U_{\text{Na}}} \text{ and the difference in the standard free energy, } E_{\text{Na,K}}^0 \text{ have been calculated}$$

with three types of clay membranes, respectively from Ca-Padegaon clay heated to 600°C, from Chinsura Ca-clay heated to 700°C, and from Aqua Gel (montmorillonitic) Ca-clay heated to 600°C. The mobility ratio of the Padegaon clay electrode varies from 1.358 to 1.411 within the range of  $a_{\text{Na}}$  and  $a_{\text{K}}$ , 0.00292 to 0.027. For the Chinsura clay electrode the variation of mobility ratio within the above activity range is somewhat greater, viz., from 1.821 to 2.210. The Aqua Gel electrodes have a much higher mobility ratio which does not vary appreciably over a wide concentration range. The same is true for the  $E_{\text{Na,K}}^0$  values, which vary from 28.34 to 31.74 mv.  $E_{\text{Na,K}}^0$  for the Padegaon membrane varies from 7.8 to 8.8 mv., and the Chinsura one from 15.4 to 20.3 mv. Using two membranes having different mobility ratios, it is easy to measure the activity of ions, e.g.  $\text{Na}^+$  and  $\text{K}^+$  in a mixture. Similar measurements are also possible for ions of dissimilar Valency and they have already been undertaken.

#### 46. Acidoid value and Surface Area of Soil Separates.

BALWANT RAI PURI, Hoshiarpur.

Acidoid value, mechanical analysis and surface area of a few H-saturated soil separates were determined on dispersion and at different stages of their slow reversion to undispersed state on gradual drying. The surface areas calculated from mechanical analysis, from water isotherm by Harvey's method and from Orchiston's semi-



empirical formula agreed with one another fairly well. Surface area and acidoid value were found to be closely related. Assuming soil surface to be covered by a monolayer of hydrated silicate complex (molecular diameter  $6 \text{ \AA}$ ) it is possible to calculate its acidoid value.

#### 47. The Reaction between Ferric Chloride and Ammonium Thiocyanate—Part II.

B. P. GYANI and Miss RANI MISRA, Patna.

Changes in light absorption of mixtures of ferric chloride and ammonium thiocyanate have been further studied (These Abstracts, 1954, p. 58). It has not been possible to obtain conditions under which the colour is stable for more than a day. A large temperature coefficient of absorption has been observed in some cases. The views concerning equilibria in these mixtures are therefore open to revision. It appears that reduction of ferric to ferrous ions takes place in solutions, more so at higher concentrations of ammonium thiocyanate, and in presence of hydrochloric acid. Even though some of the ions may be part of a complex ion, a notable portion of them are present as  $\text{Fe}^{+++}$  and  $\text{Fe}^{++}$  under all conditions studied, so that simple salts like  $\text{Fe}(\text{CNS})_3$  and  $\text{Fe}(\text{CNS})_2$  are likely to exist in these mixtures. This view is supported by the fact that slight hydrolysis to  $\text{Fe}(\text{OH})_3$  is observed in absence of hydrochloric acid.

#### 48. Some Salts of Iron with Organic Acids.

B. P. GYANI and Miss RANI MISRA, Patna.

The reaction between dilute ferric chloride and sodium acetate propionate, citrate and salicylate has been studied by the absorptiometric, conductometric and potentiometric methods. The acetate, propionate and salicylate give normal ferric salts. Only two of the carboxyls in citric acid appear to combine with iron giving  $\text{Fe}_2\text{Na}_3 \cdot \text{Citr}_3$ . In addition to the normal salt salicylic acid also gives a basic salt  $\text{Fe}_2\text{Sal}_3$  as well as an acid salt  $\text{Fe}_2\text{Sal}_2$  in which both the carboxyl and hydroxyl are likely to take part in combination.

#### 49. The behaviour of Ferric Chloride in Organic Solvents.

B. P. GYANI and Miss RANI MISRA, Patna.

Changes taking place in ferric chloride dissolved in ethyl alcohol, acetone, and ethyl acetate have been studied absorptiometrically. These changes are not of a simple nature. They are greatly influenced by the presence of even small quantities of water, and may be slowed down by the presence of apparently indifferent impurities like castor oil. The slowing down of the changes brought about by castor oil is only slight in the absence of water. When water is present the reactions appear to be self-catalysed in alcohol and acetone. The behaviour in ethyl acetate is quite different and there is no evidence of auto-catalysis. A black tar is formed if the acetone solution is exposed to air, but nothing happens even after two months if the mixture is sealed in a glass tube.

#### 50. Reduction of Potassium Permanganate by Iodide and Bromide ions in Presence of Sulphuric Acid.

B. P. GYANI and S. N. PRASAD, Patna.

Potassium permanganate may be quantitatively reduced to the manganous oxide state by iodide and bromide ions in presence of sulphuric acid. The mixture should be 4–6 normal with respect to sulphuric acid in the case of bromide. At lower

concentrations the reduction may stop at the  $\text{MnO}_2$  stage. The reduction is also inhibited at higher concentrations (8N acid). The iodide ion finally reduces the permanganate to the manganous oxide state at all concentrations of sulphuric acid (N, 2 to 6N), but there is a preliminary reduction to  $\text{Mn}_2\text{O}_7$  and  $\text{MnO}_3$ . The  $\text{MnO}_2$  stage is not observed. The mechanisms of the two reductions may therefore be quite different.

### 1. The Problem of Enhanced Light Absorption in the Ultraviolet in Iodine Reactions.

N. R. SUBBARATNAM and A. K. BHATTACHARYA Saugor.

The possible effect, on light absorption, of the strain, loosening or stretching of the bonds before the formation of the transition state in bimolecular displacement reactions was discussed by Dhar *et al.* (Jour. Ind. Chem., 11, 33, 1934; 11, 311, 1934; Ind. J. Phys., 10, 43, 1936). Other workers (Lowry and Ross, J.C.S., 622, 1926; Fukumoto, Sci. Rep. Tohoku, 21, 906, 1932) have reported an increased light absorption or a shift of the absorption to longer wavelengths in the case of individual molecules by substitution and a resultant weakening e.g. in alkyl halides. But not much is known about the strength of bonds under reaction conditions to enable any complete generalisation of the effect. The reactions with iodine are very important because it is established in these cases that iodine in brown solutions are more reactive. This is ascribed to the formation of a polarised complex with the solvent held together by Van der Waals forces (Bowen, Quart. Reviews, 4, 243, 1950). The influence of Charge-transfer forces in these cases in reducing the activation barrier was also pointed out by Mulliken recently (J. Amer. Chem. Soc., 74, 811-824, 1952). The increased light absorption of iodine in such solvents in the ultraviolet creates a new interest in testing the relation between loosening of the bond, or an intermediate loose complex and enhanced light absorption. Dhar *et al.* have observed increased light absorption in ultraviolet in all iodine reactions.

In the present investigation, the course of the reactions was followed spectrophotometrically and changes in light absorption were recorded at intervals. The results go to show that (1) there is no shift in the absorption maxima, (2) the increased extinctions in the ultraviolet were prominent at the maxima of the  $\text{I}'_3$  ion, viz. 350  $\text{m}\mu$ , and 290  $\text{m}\mu$  and (3) the increase is gradual later giving place to a gradual decrease. It is therefore concluded that the increased absorption in these cases can be explained as due to the formation of  $\text{I}'_3$  ion from the HI produced in the reaction. The decrease in the later stages is due to the consumption of Iodine by the reactant and a net decrease in  $\text{I}'_3$  also. This conclusion is substantiated from the fact that in reactions of acetic, oxalic and citric acids with Iodine, where the reaction is very slow, an initial decrease in the absorption even in ultraviolet is observed, since  $\text{I}'_3$  formation is very slow.

Thus the enhanced absorption in the case of iodine reactions need not be explained due to the loosening of  $\text{I}_2$  molecules. In view of the complexity of iodine reactions because of the various equilibria involving  $\text{HI}$ ,  $\text{I}_2$ ,  $\text{I}'_3$ ,  $\text{HIOI}$  etc., other reactions have to be examined to augment the theories of the earlier authors.

### 52. Influence of Foaming agent on the Velocity of Reduction of Haematite with Hydrogen.

A. R. GHOSH and A. N. ROY, Kharagpur.

The rate of reduction of ferric oxide with hydrogen was studied by employing a dynamical system in which the quantity of hydrogen consumed was measured at regular intervals. Comparative tests were made with an haematitic ore of Indian



origin containing 95.3%  $\text{Fe}_2\text{O}_3$  and the same material made porous by incorporating 1.9% of a foaming agent (Igal No. I, I.C.I. Ltd.). The temps. employed were 400°C, 450°C, 500°C and 550°C, the space-velocity being kept comparatively large.

A comparison of the mass-time curves shows that the improvement in reducibility is indeed highly significant. These were more marked at the lower temps. namely 400°C, and 450°C, (and at 500°C to a lesser extent), suggesting that if the reaction rate be diffusion-controlled, at higher temps. (e.g. 550°C) the diffusion of the gas takes place not only through the pores but also through the crystal lattice of the freshly reduced metal itself.

In general the rate of reduction is maximum at start, which falls off continuously, but the curves at 400°C differ in indicating an appreciable induction period. An autocatalytic mechanism with intermediate formation of magnetic oxide of iron has been put forward towards its explanation. The evidences of other workers are also discussed in this connection.

The apparent activation energy of the foamy material is calculated to be 8,000 cal./mol.

### **53. The Phase diagram study of some Binary systems.**

D. K. MAJUMDAR and P. C. RAKSHIT, Calcutta.

The system salol-naphthalene and salol-diphenyl have been studied with temperature-composition diagrams. In both cases simple eutectic points have been obtained. The curves do not admit of the existence of any solid solution. The salol-naphthalene system gives a eutectic at 25.49°C with 22% naphthalene by weight, while the other system has a eutectic at 23.38°C with 27% diphenyl by weight. The liquidus, in each case is almost ideal and the eutectic temperatures calculated with the help of clapeyron-clausius equation approach the experimental values.

### **54. Studies in Vegetable Tanning—(Part IV): Determination of Different kinds of Acids and Salts in Tanliquors by Non-aqueous Titration Technique.**

Y. NAYUDAMMA and D. RAMASWAMY.

It has been realised that acids and salts play an important role in vegetable tanning and in recent years, much attention is being devoted to the control of vegetable tanliquors by means of acid and salt contents. Vegetable tanliquors contain salts of strong and weak acids, covering a wide pK range. The titration of the different acids inevitably overlaps. The potentiometric, conductimetric and ion exchange methods have been suggested for the determination of the salts and acids in tanliquors but there is a great deal of controversy about these methods. The tanliquors in all these methods are titrated to arbitrary pH values to determine the acids and salts. Non-aqueous titration technique, thus, suggests for itself for its application to the study.

A study has been made on the titration of a number of vegetable tanning extracts in glycol, isopropyl alcohol mixture. The potentiometric titration curves have been obtained titrating with acid and base. Sharp inflections were observed in both acid and alkaline region. Clear end-points of these inflections have been taken for the evaluation of salts of weak acids and weak acids respectively. The data so obtained do not compare favourably with the results reported for the titration in the aqueous medium. The discrepancies in the results are discussed and further work in the field is suggested,

**55. Susceptibility of  $\text{CH}_2$  and Hybridisation of Carbon.**

C. R. KANEKAR, V. V. DESHPANDE and R. M. MATHUR.

The susceptibility of  $\text{CH}_2$  group has been determined from organo mercuric compounds and substituted coumarins. The value obtained from anisole and phenetole mercury compounds shows normal  $\text{CH}_2$  increment in agreement with Pascal's constants; but that from benzyl and phenyl mercury compounds is definitely lower than this value and reflects the increasing 's' character of the carbon atom of the phenyl group as compared to that of the benzyl group.

Similarly, the  $\chi_{\text{CH}_2}$  value obtained from dimethyl derivatives of coumarin is normal while that obtained from methoxy and hydroxy derivatives is definitely less. The lower value reflects the distorted  $\text{sp}^3$  hybridised state of carbon atom in the methoxy group and a positive charge on it, resulting from the bond formation with the oxygen atom.

**56. A Complete Crystal Structure Analysis of Phenanthrene by the Fourier Synthesis Method.**

B. S. BASAK, Dhanbad.

A complete analysis of the crystal structure of phenanthrene has been done by means of two-dimensional Fourier Synthesis method. Rotation, Oscillation and Weissenberg goniometer pictures have been recorded and axial lengths and space-group have been given correct values, the former values given by Mark and Hengstenberg (1929) having been found to be wrong.

Absolute intensity measurements have been carried out for the planes in three zero layer line photographs about the three crystallographic axes and two-dimensional Fourier syntheses carried out after the phase angles have been found out by the method of trial structure. Electron density maps are drawn from these Fourier summations of projected densities and the final coordinates of the atoms of a molecule as also the distribution of the molecules in the unit cell come out from these electron density maps.

The molecule is found to be planar and the bond lengths and angles have values 1.36Å—1.43Å and  $114^\circ$ — $125^\circ$  except the bond lengths  $\text{C}_9$ — $\text{C}_{10}$  and  $\text{C}_2$ — $\text{C}_3$  which have the values 1.32Å and 1.56Å respectively agreeing with the prevalent idea of organic chemists. These results have been further discussed in the light of previous and recent structure determinations.

**57. The Variation of Cationic Activity in Colloidal Clays with Concentration of the Disperse-phase.**

A. CHATTERJEE, Calcutta.

The influence of concentration of clays on the activity of  $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Ca}^{++}$  ions present in them singly as exchangeable cations has been studied with the help of clay membrane electrodes. These membranes prepared by evaporation into thin films of clay suspensions became electro-chemically reversible to cations in solution after having been suitably heat treated.

The activity measurements were carried out over a wide range of concentration of the clays, varying from 0.482 to 16.978 gms./100 gms. for Na-clay, 0.418 to 16.96 gms./100 gms. for K-clay and 0.278 to 6.008 gms./100 gms. for Ca-clay. The increase in activity with the concentration of clay, is almost linear up to 11% of Na-clay, 10% of K-clay and 5% of Ca-clay. Afterwards there is a fairly sharp fall. The double layers of K and Na-clay particles, as is expected, do not perhaps overlap owing to strong hydration, until a very high concentration is reached. For the less hydrated  $\text{Ca}^{++}$  ions the decrease in activity is shown at a relatively low concentration of Ca-clay.



The degrees of dissociation calculated from the measured activity and the total amount of ions originally present in the Na- and K-clays decrease sharply at first with concentration and then an increase followed by another fairly sharp decrease corresponding to the concentration at which the activity curve is no longer linear.

The first increase after the minimum occurs at 4-5% for Na-clay and 2-3% for K-clay. Ca-clay does not show, unlike the K- and Na-clay, the initial decrease but shows an increase in the degree of dissociation, followed by a sharp fall as it occurs in the case of Na and K-clays at a much higher concentration.

## 58. Colorimetric Estimation of Exchangeable Iron in Soils.

S. N. CHAKRABORTY, Calcutta.

Iron is present in the soil in a wide variety of ways. It may, for instance, be present in an exchangeable form, in both valence states, in many soils. This form is extractable by the sodium acetate-acetic acid buffer solution (pH 4.8) usually employed in rapid colorimetric analysis of soils. The calibration curve necessary for the purpose of quantitative determination was obtained by preparing a series of coloured solutions using Mohr's salt and plotting the colorimeter readings in the usual manner. It is found that the exchangeable iron contents of the soils so far studied vary from 10 to 400 lbs. per acre of soil. The soils have been collected from cultivated alluvial lands of Burdwan and Hooghly. The soils of Burdwan contain, on an average, a higher content of exchangeable iron than those from Hooghly.

## 59. The Evaluation of Rate Constants of First-Order Irreversible Reactions with the Help of Alignment Chart—Part I.

B. N. GHOSH and D. K. SEN, Bombay.

Usually a first-order irreversible reaction is represented as  $A \xrightarrow{k_1} B \xrightarrow{k_2} C$  where  $k_1$  and  $k_2$  are the rate constants. From the fraction decomposed (expressed in terms of  $C$ , i.e.  $y/a$  at any time  $t$ ), it is possible to evaluate the values of  $k_1$  and  $k_2$  but it is difficult to discriminate the rate constants from  $A$  to  $B$  and  $B$  to  $C$ . This ambiguity can easily be removed by making one observation on  $x$ . In the present paper we have put the solution of  $y$  in a determinantal form and have drawn an alignment chart from which values of  $k_1 t$  and  $k_2 t$  could be read off with considerable ease and sufficient degree of accuracy for any value of  $y/a$ . Better values of one of these quantities have been obtained by simple calculation. For the convenience of workers on such problems, we have prepared, from the alignment chart, tables for  $k_1 t$ ,  $k_2 t$  and  $k_1/k_2$  corresponding to values of  $y/a$  ranging from 0.15 to 0.75. A hypothetical case is given as an illustration.

## 60. Adsorption and Desorption of Organic Molecular Compounds.

K. K. DOLE and S. V. PINGLE, Poona.

Selective adsorption of the molecular compounds of picric acid with anthracene, phenanthrene, acenaphthene and of m-dinitrobenzene with p-amino-azo-benzene and 1-benzene-azo-B-naphthylamine is studied in solvents, such as, benzene and ethyl alcohol. The adsorbents used are magnesium oxide, active alumina and active charcoal. Picric acid from its molecular compounds is selectively adsorbed on all the adsorbents. The deeply coloured azo-compounds are also selectively adsorbed on charcoal from their molecular compounds with m-dinitrobenzene.

Desorption of the selectively adsorbed components of the above molecular compounds is determined in water and ethyl alcohol from all the three adsorbents. Picric acid adsorbed on magnesium oxide is completely desorbed in a certain cases. Adsorbed picric acid and m-dinitrobenzene are partly desorbed from alumina and charcoal respectively in suitable solvents. The phenomenon of selective adsorption is discussed in the light of desorption results.

#### 61. Catalytic decomposition of potassium chlorate in the presence of a mixture of catalysts and determination of the temperature coefficient of the decomposition.

G. B. KOLHATKAR and L. M. APTE.

Mixtures of the sulphate of Iron with those of (1) Nickel, (2) Cobalt, (3) Manganese, as catalysts are used to decompose Potassium Chlorate and the reactions are investigated.

It is found that a mixture of catalysts acts better than the individual components of the mixture.

The temperature coefficients of the decomposition are also determined.

#### 62. Studies on Parachor. Part I.

A. M. TALATI, Vallabhvidyanagar.

Group parachor values for the groups  $(C)CH_2OH$ ,  $(C)_2CHOH$  and  $(C)_3COH$  have been evaluated from the parachor values of the aliphatic alcohols. The differences between the parachor values of  $CH_3OH$ ,  $(C)CH_2OH$ ,  $(C)_2CHOH$  and  $(C)_3COH$  are similar to those found by Gibling (*J. Chem. Soc.*, 1941, 299) in case of  $(C)CH_3$ ,  $(C)_2CH_2$ ,  $(C)_3CH$  and  $(C)_4C$ . The results indicate that the interference correction for C-C-O should be the same as that derived by Gibling for C-C-C. The parachor value of the group  $(C)OH$  is also suggested.

#### 63. Studies on Parachor. Part II.

A. M. TALATI, Vallabhvidyanagar.

Group parachor values for the groups  $(C)CH_2NH_2$ ,  $(C)_2CHNH_2$  and  $(C)_3CNH_2$  have been evaluated from the parachor values of aliphatic amines. The differences between the parachor values of  $CH_3NH_2$ ,  $(C)CH_2NH_2$ ,  $(C)_2CHNH_2$  and  $(C)_3CNH_2$  are similar to those found by Gibling (*J. Chem. Soc.*, 1941, 299) in case of  $(C)CH_3$ ,  $(C)_2CH_2$ ,  $(C)_3CH$  and  $(C)_4C$ . The results indicate that the interference correction for C-C-N should be the same as that derived by Gibling for C-C-C. The parachor value of the group  $(C)NH_2$  is also suggested.

#### 64. Studies on Parachor. Part III.

A. M. TALATI, Baroda.

Group parachor values for the groups  $(C)CH_2Br$ ,  $(C)_2CHBr$ ,  $(C)CHI$  and  $(C)_2CHI$  have been evaluated from the parachor values of aliphatic bromides and iodides. The differences between (i)  $(C)CH_2Br$  and  $(C)_2CHBr$ , and (ii)  $(C)CHI$  and  $(C)_2CHI$  are similar to those found by Gibling (*J. Chem. Soc.*, 1941, 299) in case of  $(C)CH_3$  and  $(C)_2CH_2$ . The results are discussed as regards the interference corrections for C-C-Br and C-C-I.



**65. Studies on Parachor. Part IV.**

A. M. TALATI, Vallabhvidyanagar.

Group parachor values for the groups  $(C)CH_2Cl$ ,  $(C)_2CHCl$  and  $(C)_3CCl$  have been evaluated from the parachor values of aliphatic chlorides. The differences between the parachor values of  $(C)CH_2Cl$ ,  $(C)_2CHCl$  and  $(C)_3CCl$  are similar to those found by Gibling (*J. Chem. Soc.*, 1941, 299) in case of  $(C)CH_3$ ,  $(C)_2CH_2$  and  $(C)_3CH$ . The results are discussed as regards the interference correction for C-C-Cl.

**66. Studies on Parachor. Part V.**

A. M. TALATI, Baroda.

Group parachor values for the groups  $(C)CH_2SH$ ,  $(C)_2CHSH$ ,  $(C)_3CSH$ ,  $CH_3S(C)$  and  $(C)CH_2S(C)$  have been evaluated from the parachor values of the aliphatic mercaptans and normal and iso-sulphides. The parachor values for the mercaptan groups are correlated to those for alkyl groups and for sulphide groups. The results are discussed as regards the interference correction for C-C-S.

**67. Electro-Chemical Treatment of Clays. Part III.**

K. P. SHUKLA and C. M. PANT.

In the previous communication (Proceedings, Indian Science Congress, 1954, p. 104) it was reported that repeated leaching of clays with dilute HCl and treatment with direct electric current resulted in progressive decrease of base exchange capacity and Silica-alumina ratios. It is on account of the changes in mineral constitution of clays as exhibited by the changes in above constants that their physical properties undergo significant changes. These studies were continued. To elucidate the changes in crystal structure the dehydration and acidimetric neutralization properties were determined at every stage of treatment. Furthermore, the base exchange capacity, silica-alumina ratio, exchangeable alumina and free aluminium in clays were determined at the end of every cycle of treatment with current before subjecting it to acid leaching.

A sample each of the Soils from Central India, Madras, Punjab and Uttar Pradesh were taken for study. A sample of Kashmir Bentonite was also included in the study to afford comparison. As before colloidal fractions from each of these soils were separated out and converted into pure hydrogen clay. Direct electric current (37.5 m.Amp. and 12 Volts) was passed for  $1\frac{1}{2}$  hours in the cake of clay 1 inch thick taken between Aluminium as anode and copper as cathode. The sample so obtained was divided in two parts, one was again leached with N/20 HCl. The unleached and leached samples were analyzed chemically and subjected to dehydration and acidimetric titration studies. The leached sample was again treated with electric current and the above analysis repeated. In this way seven/eight cycles were performed.

The dehydration and titration curves afford further evidence to the fact that crystal structure of clays degenerates from a higher spongy structure to lower compact structures. This has been shown by progressive decrease in the constants base exchange capacity and silica alumina ratio.

A chemical analysis of clays before next leaching operation in certain cycle of treatment indicated an increase of base exchange capacity and silica alumina ratio. This increase is perhaps due to formation of precipitates with negative charges. Furthermore, the isomorphous replacement of silica by aluminium results in increase of electric charge. These charged compounds are, however, unstable and break

own subsequent treatment with acid. More experiments to detect the exact structure of these charged precipitates are being done.

### 68. The Role of 'Ageing' in the Production of Joshi Effect in Mercury Vapour.

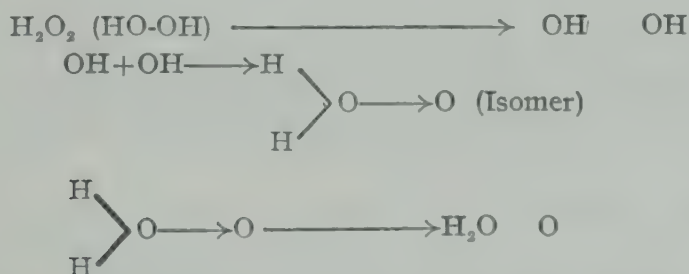
H. C. GAUR, Delhi.

For observation of Joshi effect  $\Delta i$  in mercury vapour, 'ageing', *viz.* continued exposure to discharge due to a fixed applied potential, for a period of more than 50 hours was found necessary; in view of the electro-negative nature (an essential requisite for  $\Delta i$ ) of Hg vapour (electron affinity,  $E_{\text{Hg}} = 1.79$  e.v.), this appeared to be of marked interest and called for detailed investigation on the role of 'ageing' in the production of  $\Delta i$  in Hg vapour. When this last was introduced into a freshly prepared Siemen's type discharge tube, in accord with earlier results, no  $\Delta i$  could be noticed. Raise of temperature of the (closed) discharge vessel upto  $200^\circ\text{C}$  did not initiate  $\Delta i$ . Admittance into this tube (at  $30^\circ\text{C}$ ) of hydrogen ( $E_{\text{H}} = 0.76$  e.v.) upto  $P_{\text{H}_2} = 20$  mm. Hg did not favour the production of  $\Delta i$ ; on the other hand, introduction of Cl ( $E = 3.8$ ) from chlorine, O ( $E = 3.8$ ) from oxygen and OH ( $E = 3.8$  e.v.) from water vapour gave marked  $\Delta i$ ; the quantities necessary for production of  $\Delta i$  are roughly in the order of the critical temperature of the electronegative medium. Removal of preadsorbed layers of  $\text{H}_2\text{O}$  vapour, etc. from electrode surface by suitable methods disfavoured the occurrence of  $\Delta i$ . Deposition of films like KCl, NaOH, etc. on the electrode walls aided the occurrence of  $\Delta i$  in ordinary discharge tubes with 'ageing' for a few hours. The data indicated that 'ageing' resulted in quasi-permanent changes in glass walls of the ozonisers leading to liberation of gases or/and production of surface compounds which on account of their inherent properties, gave  $\Delta i$ .

### 69. Decomposition of Hydrogen Peroxide Vapour under Electric Discharge.

N. R. RAMAIAH, Delhi.

Employing Siemen's type discharge tubes, decomposition of  $\text{H}_2\text{O}_2$  vapour due to electronic bombardment was studied. The reaction was followed by measurement of current and pressure changes. The reaction appeared to be unimolecular in nature. The studies revealed the following steps responsible for the decomposition of  $\text{H}_2\text{O}_2$ :



### 70. The study of mutual coagulation of colloids by the dropping mercury electrode measurements.

K. S. G. DOSS and S. L. GUPTA, Kanpur.

It has been shown that the dropping mercury electrode capacity measurements can be employed for studying the mutual coagulation of congo-red or congo-rubin. with methylene blue. An examination of the data reveals that the congo-red or congo-rubin is not completely precipitated by methylene blue. On the other hand the end point only indicates the region of maximum coagulation. The comparison



of the behaviours of congo-red and congo-rubin shows that the latter is less completely coagulated than congo-red. It is of interest to study this technique for determining the dye-number of sugar house products.

**71. Effect of indifferent electrolyte on the behaviour of surface active substances on the dropping mercury electrode capacity.**

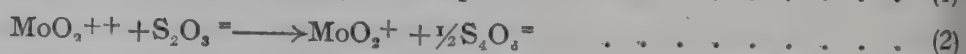
S. L. GUPTA, Kanpur.

The effect of different concentrations of potassium-chloride solution on the behaviour of benzene, isobutyl alcohol and lauryl-p-toluidine-2-sodium sulphonate on the dropping mercury electrode capacity has been investigated. It is found that the depression of capacity caused by benzene diminishes with increase in the concentration of potassium chloride. The factors responsible for this have been discussed. The important feature of the behaviour of isobutyl alcohol is the formation of a small desorption peak at about 0.13 volts at higher concentrations of the indifferent electrolyte. Owing to the presence of two peaks, lauryl-p-toluidine-2-sodium sulphonate has a complicated behaviour but one striking feature is the enhancement of the main desorption peak by increasing the electrolyte concentration. The effect of divalent cations on the behaviour of bromo-cresol purple and thymol blue on the dropping mercury electrode capacity has also been investigated.

**72. A Pseudo unimolecular Reaction: Reduction of molybdate by thiosulphate.**

D. V. RAMAN RAO and S. PANI, Cuttack.

The reduction of molybdate by thiosulphate was studied under different pH conditions. Molybdenum blue was formed at pH 1 and according to Jander (Z. anorg. Chem., 1930, 194, 383) molybdate ion changes sign at this pH and cationic molybdenum is present. Thiosulphate, in its reducing role, is oxidised either to sulphate or to tetrathionate depending on the oxidising agent. The following reactions are supposed to take place:—



The reaction (2) proceeds slowly in cold and is accelerated on heating. The reduced molybdenum has got blue colour and hence the reaction was followed at different concentrations by means of a Unicam Photoelectric Colorimeter at a wave length of 540 mμ using excess of molybdate. The values of  $K_1$  for unimolecular reaction rate are constant. Thus the above reduction answers to a pseudo-unimolecular reaction.

**73. The Dipole moment and molecular structure of quinone oximes.**

SUNDARESA SOUNDARARAJAN and K. R. KRISHNASWAMI, Bangalore.

Measurements of dielectric constants using an A.C. mains operated heterodyne beat apparatus, as also densities of solutions of different concentrations of p-nitroso phenol, α-nitroso-β-naphthol and β-nitroso-α-naphthol have been carried out and the

dipole moments of the above substances calculated from values of  $\frac{\infty}{P}$  arrived at by the application of the Hedestrand's method of extrapolation. The molar

refractions were calculated using the additivity of bond refractions of Denbigh. The

values of dipole moments are : *p*-nitroso-phenol 4.41D in dioxan solution; *α*-nitroso-naphthol 4.19D and *β*-nitroso-*α*-naphthol 4.22D in benzene solution. The structures of these compounds have been discussed from the experimentally obtained values and those calculated for various configurations by the method of vector addition of bond moments. The possibility of intramolecular hydrogen bonding in the case of the two nitroso naphthols has also been examined.

#### 4. Conductometric studies on the complexes of ferric chloride and phosphorus oxychloride.

V. V. DADAPE and M. R. A. RAO, Bangalore.

Conductivity measurements of ferric chloride and phosphorus oxychloride in nitrobenzene solutions have been carried out at 25°C. before and after heating. The sum of the conductivities of the individual components,  $\text{FeCl}_3$  and  $\text{POCl}_3$  has been compared with the actual conductivities of the complexes  $2\text{FeCl}_3 \cdot 3\text{POCl}_3$  and  $\text{FeCl}_3 \cdot \text{POCl}_3$ . Conductivity values of the heated mixtures of  $\text{FeCl}_3$  and  $\text{POCl}_3$  solutions in nitrobenzene at 25°C, employing the molar proportions  $2\text{FeCl}_3 : 3\text{POCl}_3$  and  $\text{FeCl}_3 : \text{POCl}_3$ , were of the same order as those for the respective complexes  $2\text{FeCl}_3 \cdot 3\text{POCl}_3$  and  $\text{FeCl}_3 \cdot \text{POCl}_3$ . Conductometric titrations at 25°C of nitrobenzene solutions containing different molecular proportions of  $\text{FeCl}_3 : \text{POCl}_3$ , indicated the formation of both the complexes  $2\text{FeCl}_3 \cdot 2\text{POCl}_3$  and  $\text{FeCl}_3 \cdot \text{POCl}_3$  at 0.3 molar  $\text{FeCl}_3$  concentration. With 0.2M or lower concentrations of  $\text{FeCl}_3$ , however, the titration showed the formation of only one complex viz.,  $2\text{FeCl}_3 \cdot 3\text{POCl}_3$ .

#### 75. Spectrophotometric studies on thorium and uranium complexes of morellin.

B. R. LAKSHMANA RAO and C. C. PATEL, Bangalore.

Spectrophotometric investigations carried on the mixtures of thorium and morellin alcoholic solutions in various proportions at  $\lambda = 515 \text{ m}\mu$  by Vosburgh and Cooper method indicate that there is formation of a single complex between thorium and morellin in the pH range 5 to 7. Job's continuous variation method indicates that thorium and morellin combine in the molar ratio of 1 : 4 to form the complex. This has been further supported by the slope ratio and molar ratio methods. These studies indicate the formation of the 8-co-ordinate inner complex between thorium and morellin.

Similar studies were made with uranyl nitrate-morellin systems at  $\lambda = 540 \text{ m}\mu$ . A single inner complex is also formed between morellin and uranyl ions with ratio of 2 : 1.

#### 76. Cation Exchanger from Saw dust.

A. N. DHAR, Patna.

Cation exchanging medium has been prepared by first treating the ordinary saw dust at water bath temperature with conc. Sulphuric Acid and then finally condensing the mass with resorcinol and formalin. After washing and the usual process of regeneration the H. Form mass which is blackish and insoluble in common solvents shows a capacity of 0.33 m. eq/g. dry resin from limiting exchange with  $\text{BaCl}_2$  soln. while the capacity at pH 11 (green fluorescence visible) in presence of N/5 NaCl soln is 2.2 m. eq/g. dry resin. A valuable use of saw dust is envisaged.



**77. Cation Exchange Resins from Shellac.**

A. N. DHAR, Patna.

Cation exchange resins have been prepared by the condensation of (A) sulfited shellac, (B) acid modified shellac with Resorcinol and paraformaldehyde in alkaline (caustic soda) medium. The values for the two types of resin are :—

**ION EXCHANGE CAPACITY OF RESINS**

(values expressed in m.eq./g. air dry resin)

Resin	In presence of NaCl at 25°C., pH 7	From BaSO <sub>4</sub> determination	From limiting exchange with BaCl <sub>2</sub> solution
A.     ...     ...	0,981	0,943	0,942
B.     ...     ...	0,041	0,039	0,039
Shellac ...     ...	—	—	0,012

The resins have been found quite suitable for the removal of Ca, Ba, Mg, Co, Ni etc. The resins are hard and insoluble in common solvents.

It is evident from the table that the resin prepared from sulfited shellac is of far more improved capacity and compares favourably with the other cation exchange resins.

**78. Differential Thermal analysis of promoted Silver Oxide Catalysts.**

I. B. GULATI and S. K. BHATTACHARYYA, Kharagpur.

The differential thermal analysis of a number of promoted and unpromoted catalysts e.g. silver oxide, silver oxide promoted with barium peroxide, potassium carbonate, and oxides of lead, copper and iron (each containing 4 atoms of promoter per 100 atoms silver) developed by us for the oxidation of ethylene to ethylene oxide has been studied. Precipitated, oven-dried, silver oxide gives a characteristic endothermic peak at 230°C marking the decomposition of the oxide. In the barium peroxide promoted catalyst the temperature of oxide decomposition is lowered by about 30°C. The addition of potassium carbonate raises the decomposition temperature by 50°, while the lead oxide promoted catalyst does not show any endothermic peak up to about 400°C. In the case of copper oxide and iron oxide promoted catalysts the endothermic peak is masked probably by exothermic reactions occurring at that temperature. As reported earlier the addition of barium peroxide enhances the catalytic activity of silver oxide appreciably whereas both potassium carbonate and lead oxide lower the activity. Thus the catalytic activity of the promoted catalysts depends to some extent on the temperature of decomposition of silver oxide. Barium peroxide which lowers the temperature of decomposition enhances the activity while potassium carbonate and lead oxide which lower the activity raise the temperature of decomposition.

**79. Differential Thermal analysis of Catalyst powders: System: ThO<sub>2</sub>Al<sub>2</sub>O<sub>3</sub>**

Miss S. KAMESWARI, V. S. RAMACHANDRAN and S. K. BHATTACHARYYA, Kharagpur.

The binary mixture of thorium oxide (ThO<sub>2</sub>) and aluminium oxide (Al<sub>2</sub>O<sub>3</sub>) is a very important catalyst for iso-synthesis for the production of iso-paraffins,

The differential thermal analysis of thorium oxide and aluminium oxide in powdered form were studied individually and in admixtures in different proportions in order to find out the possible mechanism of catalytic activation. The results may be summarised as follows:—

Thorium oxide exhibits an endothermal peak at 140°C which is due to the loss of adsorbed water from the oxide. There is an exothermal trend at a temperature of about 360°C which probably indicates the beginning of sintering.

The hydrous aluminium oxide obtained both by precipitation and hydrolysis of alkali aluminate shows two endothermal peaks. The low temperature endothermal peak at about 145°C in both cases may be due to the loss of adsorbed water. This is followed by a second endothermal peak (peak temperature 430° for that obtained by precipitation and 320°C for that obtained by alkali aluminate) which may be due to the formation of  $\gamma\text{-Al}_2\text{O}_3$ . There is no indication of the formation of bohmite. At a higher temperature of about 970°C there is an exothermal rise due to the onset of formation of  $\alpha\text{-Al}_2\text{O}_3$ . Usually  $\text{Al}_2\text{O}_3$  is used as a dehydration catalyst after heating it just below 400°C, above which temperature the formation of  $\gamma\text{-Al}_2\text{O}_3$  takes place.

The addition of  $\text{K}_2\text{CO}_3$  to  $\text{ThO}_2$  decreases to a great extent the slope due to sintering.

There is an indication that the degree of sintering is less in separately mixed  $\text{ThO}_2:\text{Al}_2\text{O}_3$  than that prepared by coprecipitation.

## 80. Thermal decomposition of Diazo-salt under pressure.

K. S. DE and S. K. BHATTACHARYYA, Kharagpur.

Investigations have been carried out on the thermal decomposition of p-toluene diazonium sulphate in the solid phase at temperatures of 50°, 140° and 200°C in an inert atmosphere of nitrogen at 55 and 130 atmospheres.

The decomposition resembles other explosive decompositions and the pressure-time curves are found to be approximately of sigmoid type. The results are found to agree well with the Prout and Tompkins equation:

$$\log_{10} \frac{p}{p_{\infty} - p} = k_1 t + C_1$$

(where  $p$  = pressure at a time 't',  $p_{\infty}$  = final pressure, and  $k_1$  &  $C_1$  are constants.)

In this case, the main reaction involves only the fission of diazo nitrogen. The reaction has been found to be irreversible at all temperatures and pressures. The rate of decomposition increases with increasing temperature but seems to be independent of external pressure.

## 81. Interaction of Histidine with Sugars in aqueous solutions studied potentiometrically. Part I: Glucose.

C. S. MARWANI and P. P. SINGH, Bombay.

From potentiometric titrations of aqueous solutions of histidine with glucose solution, it has been established that at 30°C and pH 7.5 to 8.7, there is a chemical reaction between the two, the interaction of the amino-group of histidine and the aldehyde group of the sugar, being marked by a decrease in the pH. The kinetics of the reaction, decarboxylation of the reaction product and the influence of the same on the dilatation of capillaries of muscles are under investigation.



**82. Kinetics of Nucleation in Supercooled Solutions.**

R. P. RASTOGI, Lucknow.

It has been shown previously that generalized Volmer-Frenkel theory of two-dimensional crystallization velocity can successfully explain the observed facts (J. Phy. Chem. (in press)). In this paper the Volmer-Frenkel theory of nucleation has been applied to the supersaturated solutions of solids in liquids. An expression for the maximum rate of nucleation is deduced. It has been shown that the surface free energy at the crystal-solution interface can be computed from the observed maximum rate of nucleation. Calculations have been made for several systems.

**83. Thermodynamics of solutions of mixed electrolytes.**

R. P. RASTOGI and K. T. RAMA VARMA, Lucknow.

The generalized thermodynamic theory based on Gibbs' method (Srivastava and Rastogi, Proc. Nat. Inst. Sci. India, 1953, 19, 613-22) for multi-component systems has been extended to solutions containing several electrolytes. The treatment is based on the model that the electrolytes are completely dissociated. Liquid-vapour equilibrium, solid-liquid equilibrium and solid-liquid-vapour equilibrium have been investigated. Explicit equations for isothermal, isobaric changes including changes at constant compositions are deduced taking into account the Debye-Hückel theory and the non-ideal nature of the vapour phase. The variation of vapour pressure of saturated solution of sparingly soluble electrolyte is also discussed. It has been pointed out that the depression in freezing-point and elevation of boiling-point can yield values of activity coefficients which can be checked against the values obtained by the extension of Debye-Hückel limiting law for solutions of mixed electrolytes.

**84. Non-equilibrium Thermodynamics of Thermal Transpiration of  $N_2O_4$ .**

R. P. RASTOGI and R. C. SRIVASTAVA, Lucknow.

In a previous communication (Rastogi and Srivastava, Proc. Phy. Soc., London, 1954, 67, 639) the non-equilibrium thermodynamics of thermal transpiration of the species involving the reaction  $X_n \rightleftharpoons nX$  was developed. For mixture of perfect gases and binary dissociation, it has been shown in this paper, that the deviation from chemical equilibrium in the two chambers is given by the following relations:

$$\delta c_1^I = \left\{ \Delta T / T^I \left( \frac{1}{c_1^0} + \frac{2}{c_2^0} \right)^I \right\} \left( \frac{L_{cc'}}{L_{cc} + L_{cc'}} \right) \left[ \frac{3}{2M_2} \cdot \frac{\Delta \log p}{\Delta \log T} - \left( 1 + \frac{2c_1}{c_2} \right) \frac{\Delta \log c_1}{\Delta \log T} - \frac{15}{4M_2} \right]$$

$$\delta c_1^{II} = \left\{ \Delta T / T^{II} \left( \frac{1}{c_1^0} + \frac{2}{c_2^0} \right)^{II} \right\} \left( \frac{-L_{cc}}{L_{cc} + L_{cc'}} \right) \left[ \frac{3}{2M_2} \cdot \frac{\Delta \log p}{\Delta \log T} - \left( 1 + \frac{2c_1}{c_2} \right) \frac{\Delta \log c_1}{\Delta \log T} - \frac{15}{4M_2} \right]$$

where  $\Delta$  denotes the difference of the respective quantities in chambers I and II and  $\delta c_1^I$  and  $\delta c_1^{II}$  denotes the change in the concentration in chambers I and II on account of thermal effusion. The subscripts refer to the two components,  $M$  denotes the molecular mass and  $L_{cc}$  and  $L_{cc'}$ , are related to kinetic co-efficients. The reaction  $N_2O_4 \rightleftharpoons 2NO_2$  has been investigated by using the available equilibrium data on thermal dissociation to indicate the magnitude of the shift from thermodynamic equilibrium.

**85. Thermal Decomposition of Formaldehyde at High Pressure.**

D. K. NANDI and S. K. BHATTACHARYYA, Kharagpur.

Thermal decomposition of formaldehyde has been studied at a temperature 200°C-400°C and a pressure 480-4000 psi. It has been reported by previous workers

Formaldehyde is not decomposed to carbon monoxide and hydrogen at a temperature below  $300^{\circ}\text{C}$  at atmospheric pressure. But results of the present investigation show that it is decomposed to carbon dioxide, carbon monoxide and hydrogen at  $200^{\circ}\text{C}$  when it is subjected to high pressure. It is found that with increase of pressure, percentage of carbon dioxide increases while that of carbon monoxide and hydrogen decreases.

Carbon particles have been found to be deposited at the bottom of the high pressure reactor. The mechanism of the decomposition of formaldehyde under pressure has been suggested.

## 6. Conductometric Estimation of Thorium and Cerium.

D. SINGH, Banaras, and P. G. MENON, Kharagpur.

Conductometric titrations of thorium chloride against ammonium oxalate, oxalic acid, silver nitrate and potassium tartrate, and of cerous chloride against these titrants except silver nitrate were carried out at high dilutions (10.0, 5.0 and  $3 \times 10^{-4}\text{M}$ ) of the chlorides. The formation of thorium-ammonium oxalate or other complexes is not marked in this region at room temperature. Oxalic acid proved to be the most suitable titrant for thorium estimation within  $\pm 1.0\%$  of experimental error. The other titrants fail to produce accurate results. Our earlier results for the estimation of cerium (*Curr. Sci.*, 22, 73, 1953) showed good agreement between experimental and theoretical values. A sharp and pronounced break in the conductivity curves is observed with ammonium oxalate. The results also reveal three-stage ionization of thorium chloride—(a)  $\text{ThCl}_2^{++}$ , (b)  $\text{ThCl}^{+++}$ , (c)  $\text{Th}^{++++}$ , and two-stage of cerous chloride—(a)  $\text{CeCl}_2^{+}$  (b)  $\text{Ce}^{+++}$ , which are in agreement with recent observations of other workers from ion-exchange studies and radio-chemical assay. In case of mixtures of thorium and cerous chlorides only one equivalence point, corresponding to the complete precipitation of the total quantity of salts, is observed. The striking contrast in the behaviour of these two electrolytes in precipitation reactions has been clearly brought to light. It would be of interest to extend the work to study the behaviour of Ti, Zr, Hf and the rare-earth elements in such precipitation reactions.

## 7. Potentiometric Estimation of Sulphide.

D. SINGH, Banaras, and P. G. MENON, Kharagpur.

Potentiometric titrations of sodium sulphide against mercuric chloride in aqueous solutions have been carried out comparatively by two methods: (1) Pinkhof's bottled equivalence point, which yields results within  $\pm 3.6\%$  error; (2) direct method, using a single mercury electrode coupled with a saturated calomel electrode as the reference one; the observed results are in essential agreement with the theoretical value and the error is well within  $\pm 0.4\%$ . It is, thus, shown that the latter is an improvement over the results of Pinkhof.

## 8. Variation of the Sulphide Concentration of Aqueous Hydrogen Sulphide Solutions with Time.

D. SINGH, Banaras, and P. G. MENON, Kharagpur.

The variation of sulphide contents in aqueous hydrogen sulphide solutions with time under different conditions has been studied. A quantitative comparison of the influence of dissolved gases especially oxygen and of atmospheric exposure has been made; other factors like hydrogen-ion concentration, influence of wall surfaces, size and shape of container, initial concentrations, etc. have also been closely examined. The effect of light on dissipation of hydrogen sulphide has

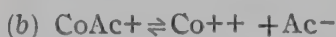


been preliminarily studied. It has been observed that concentration of such solutions can be maintained for about five hours provided it is kept air-free, and also out of contact with gas phase by means of a thin (upper) layer of paraffin oil. A detailed study of the photochemical kinetics of this colloid-forming system would be of fundamental importance in elucidating the reaction mechanism involved and also in the domain of photochemistry.

### 89. The Dissociation of Cobalt Acetate in Aqueous Solution.

SUSHIL KUMAR SIDDHANTA and SATYENDRA NATH BANERJEE,  
Kharagpur.

Cobalt acetate dissociates in aqueous solution in two stages, viz.,



The first and second dissociation constants of cobalt acetate are therefore given by,

$$K_1 = \frac{[\text{CoAc}^+][\text{Ac}^-]}{[\text{CoAc}_2]}$$

$$\text{and, } K_2 = \frac{[\text{Co}^{++}][\text{Ac}^-]}{[\text{CoAc}^+]} \text{ respectively.}$$

In the present paper the values for  $K_1$  and  $K_2$  have been determined at room temperature by following the equilibrium hydrogen ion concentrations in mixtures of cobalt acetate and nitric acid solutions. The value of  $K_2$  has also been found out by determining the equilibrium hydrogen ion concentrations in mixtures of cobalt nitrate and acetic acid and solutions.

The mean values for  $K_1$  and  $K_2$  have been found to be  $53.8 \times 10^{-3}$  and  $8.8 \times 10^{-3}$  respectively at  $29^\circ\text{--}30^\circ\text{C}$ .

### 90. Reaction in the substrate formed on a Cobalt Fischer-Tropsch catalyst.

J. C. GHOSH, M. V. C. SASTRI and T. S. VISWANATHAN, Kharagpur.

The authors had previously indicated that an important preliminary step in the Fischer-Tropsch synthesis is the initial formation of a carbon-oxygen-hydrogen substrate on the catalyst surface. The present work was undertaken to study the properties of this substrate, especially its thermal stability and its further reactions with hydrogen gas or carbon monoxide.

The catalyst used was Cobalt : Thoria : Kieselguhr (100 : 18 : 200). The substrate was formed by exposing the surface to a mixture of  $1 \text{ CO} : 2 \text{ H}_2$  at  $0^\circ\text{C}$ . The equilibrium was chilled by cooling the system to  $-78^\circ\text{C}$ . and the gas phase was evacuated while maintaining the catalyst at this temperature. The evacuation was stopped and the catalyst temperature brought up to  $0^\circ\text{C}$ .

The substrate so formed was found to be thermally stable and did not dissociate to any detectable extent on raising the temperature from 0 to  $100^\circ\text{C}$ . The uptake of hydrogen gas by the substrate progressively increased both in quantity and in rate as the temperature of the catalyst was raised from 0 to  $100^\circ$ . The uptake of carbon monoxide by the substrate was very little and did not vary appreciably with temperature. When the surface was initially covered with pure carbon monoxide instead of a carbon monoxide-hydrogen mixture, and the uptake of hydrogen studied on such a surface, the results indicated that carbon monoxide-hydrogen complexes were initially formed and these took up further amounts of hydrogen as in the experiments reported above. It appears that the initial step in the Fischer-Tropsch reaction is the formation of a carbon monoxide-hydrogen substrate which is progressively hydrogenated to give hydrocarbon fragments.

**1. Distribution of the sparingly Soluble Salts in Banded Structures. Part III.**

A. C. CHATTERJI and M. C. RASTOGI, Lucknow.

The distribution of eight sparingly soluble salts of rarer elements in both types of banded structures has been studied. The analysis of the bands and the spaces shows that the variation of the distribution ratio in the case of first type of rings, is over a long range, while in the second type it is almost the same.

**2. Pressure—Composition Isothermals of the Systems : Zinc Sulpha- $\alpha$ -Picoline-Water and Cadmium Sulphate- $\alpha$ -Picoline-Water at 60°C.**

P. C. SINHA and G. C. BHATTACHARYA, Patna.

Pressure-composition isothermals of these two systems at 60°C have been determined. Only the following solid phases were found to exist under the condition of the experiment studied :—

$\text{ZnSO}_4 \cdot 1 \text{ Pico. } 5 \text{ H}_2\text{O}$  and  $\text{ZnSO}_4 \cdot 1 \text{ Pico. } 2 \text{ H}_2\text{O}$  for the Zinc sulphate system, and  $\text{CdSO}_4 \cdot 2 \text{ Pico. } 2 \text{ H}_2\text{O}$  and  $\text{CdSO}_4 \cdot 2 \text{ Pico. } 1 \text{ H}_2\text{O}$  for the Cadmium Sulphate system. No loss of Picoline was observed at 60°C even when the pressure was lowered to about 3 mms. The rate of rehydration of  $\text{ZnSO}_4 \cdot 1 \text{ Pico. } 2 \text{ H}_2\text{O}$  is rapid while that of  $\text{CdSO}_4 \cdot 2 \text{ Pico. } 1 \text{ H}_2\text{O}$  was very slow.

**3. Role of Inductomeric effect in the decomposition of Diazonium Chlorides.**

C. R. TALPADE, Bombay, and K. Z. PATIL, Kharagpur.

The study of kinetics of decomposition of Diazonium Chlorides from sulphamic acid, sulphanilamide, sulphapyridine and sulphathiazole was carried out under identical experimental conditions like temperature, concentration and pH, when the following values of the rate of decomposition at 60°C. were obtained.

(1)  $-\text{SO}_3\text{H}-20.97$ .(2)  $-\text{SO}_2\text{NH}_2-17.13$ .(3)  $-\text{SO}_2\text{NH.C}_3\text{H}_2\text{NS}-15.0$ .(4)  $-\text{SO}_2\text{NH.C}_5\text{H}_4\text{N}-107.7$ .

The diazonium chlorides are stabilised to a considerable extent by the substitution of negative groups. But when there is substitution in the negative group ( $-\text{SO}_3\text{H}$ ), the stability and hence the rate of decomposition of diazonium chlorides etc. depend upon the influence of the inductomeric effect.

**4. Casein viscosity in proteinase evaluation.**

RAMAPRASAD BANERJEE and SUDHISH NANDY, Calcutta.

Viscometric methods are often used for the estimation of proteolytic activity. Gelatine has been most frequently employed as substrate for such determinations. The principal advantage of gelatine as substrate would seem to be its solubility at all hydrogen ion concentration, thus making it suitable for enzymes with widely varying pH-optima.

The use of gelatine in quantitative work, however, may not be desirable on other considerations. The absence of the amino acids, tyrosine and tryptophane, in gelatine would result in the lack of certain peptide linkages with particular side chain characteristics in the gelatine chain. Proteinases exhibiting specificity with respect to these linkages would therefore be inadequately evaluated by gelatine viscosity method. A protein containing all the principal amino acids is favoured on the above consideration. Casein is suggested.

Casein unlike gelatin has globular molecules. Viscosity of casein solutions upon action by proteinase, however, falls off in an almost exactly similar manner as with a gelatine sol. There is a sharp fall in viscosity in the initial few minutes,



followed by a moderate decrease with time as digestion proceeds. The rapidity of the initial decrease in viscosity does not represent a corresponding cleavage of peptide bonds. However, arbitrary limits can be set (75 p.c. to 60 p.c. of initial) between which the rate of change of viscosity is proportional to enzyme concentration. Experiments with a number of enzymes at various dilutions (trypsin, mold proteinases from *A. paraciticus* etc.) show the validity of the above relation.

With appropriate buffers used, the measurement of viscosity reduction of casein offers a simple and quick method for the quantitative evaluation of proteinases with pH optima above 6.

#### 95. Oxidation of Glycerol with Ceric Sulphate.

N. N. SHARMA and R. C. MEHROTRA, Allahabad.

The oxidation of glycerol with various oxidising agents has been studied by several workers. Cathill and Atkins (1938) studied the oxidation of glycerol by ceric sulphate in presence of dilute sulphuric acid and came to the conclusion that eight equivalents of oxygen are required for each mole of glycerol present. They further inferred that probably tartronic acid is formed under these conditions which is not oxidised further by ceric sulphate.

In the course of these investigations, it has been found that although the equivalents of oxygen used up by glycerol under the conditions employed by the above workers was approximately eight, yet it varied slightly according to the concentration of sulphuric acid and the time of refluxing. Further, it has been shown that tartronic acid itself is completely oxidised by ceric sulphate within ten minutes and hence, it cannot be the end product in the oxidation of glycerol.

By increasing the concentration of sulphuric acid in the reaction mixture, it has been possible to oxidise glycerol completely to carbon dioxide and water. It appears that as with many other organic compounds, formic acid is the end product in the oxidation of glycerol also. The formic acid is only slowly oxidised by ceric sulphate in the presence of dilute sulphuric acid, but its oxidation can be brought to completion by increasing the concentration of sulphuric acid in the reaction mixture.

#### 96. Oxidation of Citric Acid by Ceric Sulphate.

N. N. SHARMA and R. C. MEHROTRA, Allahabad.

The oxidation of citric acid by various oxidising agents has been studied by several workers. With ceric sulphate in presence of dilute sulphuric acid, Willard and Young (1930) have shown that citric acid requires sixteen equivalents of oxygen per mole and according to them acetone di-carboxylic acid is the first product which is 'oxidised extensively' afterwards. For complete oxidation, citric acid would have required eighteen equivalents of oxygen.

In the course of the present investigations, it has been found that citric acid is able to consume about sixteen equivalents of oxygen fairly rapidly (in less than five minutes at the boiling temperature). Acetone itself has been shown to be oxidised quite slowly to a mixture of formic and acetic acids. The rapid rate and the stoichiometric nature of the reaction between citric acid and ceric sulphate shows that it does not proceed *via* acetone.

We have shown earlier that formic acid can be completely oxidised by ceric sulphate in presence of a high concentration of sulphuric acid. It has been found that the product formed by the initial oxidation of citric acid by ceric sulphate shows a behaviour similar to formic acid.

Apart from theoretical interest, the results in these investigations provide a very satisfactory method for the analysis of mixtures of oxalic and citric acids for which only empirical methods were available till now.

## 7. Mixed Tertiary Alkoxides of Zirconium.

R. C. MEHROTRA, Lucknow.

Mixed tertiary alkoxides of zirconium were first prepared in the attempts to prepare zirconium tetra-tertiary butoxide from zirconium primary alkoxides. A novel method for preparing the mixed tertiary alkoxides of zirconium has been described in this communication which consists in treating zirconium tetra-tertiary alkoxide with a calculated quantity of primary alcohol. A highly exothermic reaction occurs and the new compounds,  $\text{Zr (OMe) (OBu}^t)_3$ ,  $\text{Zr (OMe)}_2 \text{ (OBu}^t)_2$ , and  $\text{Zr (OEt)}_2 \text{ (OBu}^t)_2$  have been prepared by this procedure. A rough measure of the

heat of reaction gave the energy of the bond  $\text{Zr} \begin{array}{c} \text{R} \\ \diagup \\ \text{O} \end{array} \rightarrow \text{Zr}$  as 8 kcal. The preparation of pure compounds by the above simple procedure indicated a ready radical-interchangeability among the alkoxy groups in these compounds and this has been experimentally shown to be correct. Ebullioscopic measurement of molecular weights of the mixed alkoxides shows them to be associated indicating that steric and not (+I) effects determine the associated nature of the alkoxides.

## 8. Oxidation of Phenolic compounds with Ceric Sulphate.

N. N. SHARMA and R. C. MEHROTRA, Allahabad.

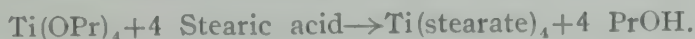
The oxidation of phenols by ceric sulphate has been studied by several workers. Spencer and Duke (1954) have suggested empirical methods for the estimation of phenols by oxidation with ceric sulphate. It has been shown in the present investigations that the phenols can be oxidised completely to carbon dioxide and water. The conditions under which the oxidation proceeds to completion have been studied. The results provide satisfactory analytical methods for the estimation of phenol and resorcinol.

## 9. Soaps of Titanium.

R. C. MEHROTRA, Lucknow.

The heavy metal soaps are finding increasing use in industry. Ryan and Pletcher (1934) attempted to prepare titanium soaps by the reaction between titanium tetrachloride and the corresponding fatty acid in which calcium carbonate equivalent to the tetrachloride had been dispersed. Water is formed as a result of the above reaction and in its presence, the soap will have a tendency to get hydrolysed. It has not been possible to get consistent results by the above procedure.

It has been shown in the present investigations that titanium isopropoxide reacts with stearic acid according to the following equation:



The above reaction can be pushed to completion if the isopropyl alcohol formed is continuously fractionated off as azeotrope with benzene. The reaction, thus, provides a ready and convenient method for the preparation of titanium soaps.

## 10. The Potentiometric study of Double Salts.

S. K. K. JATKAR and K. A. KHASGIWALE, Poona.

The potentiometric measurements of oxidation—reduction potentials of the metal ions of Ag, Cu, Co, Ni, Fe, Cr and Cd, have been carried out in the presence



of varying proportions of potassium and sodium salts using the system pt/solution/Sat: KCl or  $\text{KNO}_3$ /Sat:  $\text{KCl.Hg}_2\text{Cl}_2/\text{Hg}$ . The study has been carried out by continuous variation method, in two different concentrations, and both direct and reverse titrations have been carried out. The striking changes in redox potentials correspond to the general formula  $\text{M. (K or Na)}_x$ , where  $\text{Ni}=\text{Metal ion}$  and  $\text{X}=5, 1.2, \dots 8$ , etc. The formation of these additive compounds has been explained on the basis of interionic attraction theory and regular arrangement of ion in solution, corresponding to that in the solid state as postulated by Milner and Ghosh.

### 101. Absorption Spectra of Coumarins.

S. K. K. JATKAR and B. N. MATTOO, Poona.

The absorption spectra of coumarins in alcoholic (87%) solution have been studied in the range  $2100\text{\AA}^\circ$ — $4000\text{\AA}^\circ$  with a Beckman Quartz DM spectrophotometer. Concentrations of  $1 \times 10^{-4}\text{M}$  were found convenient.

To check up the settings of wavelength and calibration of density scale, well known u.v. absorption spectra of Benzene, Naphthalene, Anthracene, Potassium dichromate in  $\text{H}_2\text{SO}_4$ , and Potassium chromate were repeated. The spectra were reproduced in  $\lambda$  max. extinction values and fine structure of the bands.

The absorption spectrum of simple coumarin shows two bands with maxima at  $274.5\text{ m}\mu$  and  $311\text{ m}\mu$ . The high frequency band viz.  $274.5\text{ m}\mu$  has the same position as that of cumalinic acid (5-carboxy,  $\alpha$ -pyrone). The  $274.5\text{ m}\mu$  band is common to other hydroxy coumarins also, and therefore may be attributed to the  $\alpha$ -pyrone structure common to these.

6-OH, 4-Me coumarin has three bands with maxima at  $225\text{ m}\mu$ ,  $276\text{ m}\mu$  and  $345\text{ m}\mu$ , these being in the decreasing order of the intensity of absorption. 5-OH, 4-Me coumarin shows an inflexion at  $223\text{ m}\mu$ , one band at  $252\text{ m}\mu$  and a strong band at  $296\text{ m}\mu$ . The acetates of 6-OH and 5-OH derivatives show similar spectra more or less resembling that of simple coumarin.

The 7-OH, 4-Me coumarin ( $\beta$ -methyl-umbelliferone) shows a radically different absorption spectrum. 7-OH coumarins or umbelliferones also differ from other hydroxy coumarins in their fluorescing property. They are highly fluorescent and the emission varies with pH, being more intense in alkaline range (unpublished work).

$\beta$ -Methyl umbelliferone (BMU) shows a strong absorption max at  $218\text{ m}\mu$  and another equally strong band with a maximum at  $328\text{ m}\mu$ , there being no band in the region of  $2700\text{ \AA}^\circ$ , common to coumarin and other hydroxy coumarins.

### 102. Diffusion and Activation control in Heterogeneous liquid—liquid system.

P. S. JAVADEKAR, Sangli.

A reaction between benzaldehyde in chlorobenzene and aqueous acidified potassium permanganate has been studied. The effect of change in concentration of benzaldehyde shows no appreciable increase in the velocity of reaction. The effect of change in concentration of permanganate however is appreciable. The temperature coefficients (about 1.6) between  $28^\circ\text{C}$  and  $38^\circ\text{C}$  indicate neither the predominance of the diffusion process nor the chemical process. It is interesting to note that the change in speed of stirring has hardly any influence on the rate of the reaction. This is thus a rare example of a reaction in which the velocity of the chemical reaction and the velocity of diffusion are comparable in magnitude.

### 103. Studies in the change of Hydrogen Ion concentration of Colloidal Ferric Hydrous Oxide Sol during its coagulation by Potassium Sulphate.

R. S. RAI and S. GHOSH, Allahabad.

Five samples of the Sol of hydrous ferric oxide were prepared and different amounts of potassium sulphate were added to a constant volume of the Sol, and the mixture was made to a constant volume. pH of the samples were determined by  $L$  and  $N$ .pH indicator.

It was observed that pH value of the Sol increased by the step-wise addition of Potassium Sulphate. This change was quite appreciable and so much so that the Sol, which was quite acidic in nature became neutral. The experimental observations when represented on a graph indicated a Bilogarithmic curve, asymptotic in nature, and the bend was quite prominent near about the coagulation point.

From the data presented here, it was inferred that the sulphate ion neutralizes the charge of the colloidal micelle and is itself adsorbed on the colloidal surface. This led to the increase of the adsorption of hydroxonium ions by the partially neutralized surface. This resulted in the liberation of alkali and consequently in an increase in the pH value. The variation and the decrease of the electric charge on the colloidal surface continues even beyond the coagulation point. Since the surface decreased after the coagulation the curve shows a variation.

It has been emphasized that the generation of alkali as noted here, is not due to the replacement of OH radicals in the hydrous micelle as postulated by Thomas and co-workers. Further there is no evidence of the existence of basic salt in the colloidal micelle.

### 104. Intermolecular Potential in a Molecular Assembly.

RANAJIT SENGUPTA, Kharagpur.

To what extent the interaction potential of two molecules is influenced by the presence of other molecules is one of the fundamental problems in the theory of assembly of molecules, especially in the condensed phase, and is still unsolved. The following arguments afford the possibility of finding a definite answer to the problem. It has been shown by the present author (unpublished results) that non-Newtonian potential fields though do not obey Laplace-Poisson equation, they obey following ones:—

$$\Delta^2 W(r) + f(r) W(r) = 0 \quad \text{[in the region where source is absent]} \quad (1)$$

$$\Delta^2 W(r) + f(r) W(r) = -4\pi a \rho \quad \text{[in the region where source is present]} \quad (2)$$

where  $f(r)$  is given by the relation

$$\frac{1}{r^2} \frac{d}{dr} r^3 \frac{d}{dr} \phi(r) + f(r) \phi(r) = 0 \quad (3)$$

where  $\phi(r)$  is the law of non-Newtonian interaction considered, and is a constant depending on the cut off radius (if  $\phi(r) \rightarrow \frac{1}{r^p}$ ,  $p > 1$ , as  $r \rightarrow 0$  consideration of a cut off radius is essential in order to avoid the strong divergence at the origin). These relations enable one to formulate the following equation for the overall intermolecular potential for an assembly of  $N$  molecules—

$$\Delta^2 \psi(r) + f(r) \psi(r) = -4\pi n N C e^{-w/kt} \quad (4)$$

an equation analogous to Boltzman-Poisson-Debye equation in the theory of strong electrolytes.



This equation can be easily solved if suitable approximations are introduced and the boundary conditions are fixed by the relations:—(1)  $\psi(r) \rightarrow 0$  as  $r \rightarrow \infty$  and (2)  $\left(\frac{\delta\psi^x(r)}{\delta r}\right)_{r=a} = 0$  where  $\psi^r(r) = \psi(r) - \phi(r)$  the net contribution on the inter-molecular potential by the molecluster.

#### 105. On Liquid-Liquid Junction Potentials between some Uni-univalent Electrolytes.

S. N. DAS.

Liquid-liquid junction potentials of solutions of hydrochloric acid in contact with solutions of Lithium Chloride, Sodium Chloride and Potassium Chloride have been measured at 25°C. under two different conditions. In one series a sharp junction was produced by momentary contact of drops of the two liquids while in the other a continuous variation of concentration of the two solutions was secured in the boundary layers. The first was supposed to secure the conditions necessary for the application of Planck's formula, while the second was suitable for Henderson's formula. The differences of potential for the two cases have been calculated by Cummings and Gilchrist for a number of solutions. It was found that the experimental values observed by us agree very well with the calculated values for N/1 HCl—N/1000 KCl, although slight discrepancies in the observed E.M.F. values were observed in the case of N/10 HCl—N/10 NaCl and N/10 HCl—N/100 NaCl. Other cases showed some departures from the calculated values.

#### 106. Studies on counter-current distribution and applications. Part II.

S. B. GHOSH, G. P. SEN, and P. NANDI, Calcutta.

The counter-current distribution of a solute between two immiscible solvent phases is governed by a simple binomial equation, which is based on the tacit assumptions that unit mass of solute is distributed between the solvent phases and that the distribution coefficient is equal to unity. The simplified equation has been critically examined and two equations have been deduced which take into consideration cases other than the ideal one. In their limiting forms, the equations put forward are reduced to the classical one.

#### 107. The adsorption of gases on metal powders at low temperatures.

ASHA AGA and M. R. A. RAO, Bangalore.

Metal powders of iron, cobalt and nickel have been prepared by different methods for adsorption studies. The adsorption isotherms of nitrogen, argon and carbon-monoxide have been obtained at  $-190.5^\circ$  and of ethane and ethylene at  $-80^\circ\text{C}$ . on these powders. The volume of the gases necessary to form a monomolecular layer on the surfaces ( $V_m$ ) and the specific surface areas of the powders have been calculated by the application of the B.E.T. equation to the adsorption data. The S.A. values obtained with  $N_2$  and  $C_2H_4$  are in good agreement while those obtained with A and  $C_2H_6$  are lower by about 16% and 10% respectively in all the cases. The surface areas of the metals also depend on the method of preparation of the sample.

CO is adsorbed to a much greater extent than  $N_2$  at equal relative pressures. The ratio of the difference between the volume of CO and  $N_2$  adsorbed ( $V_{CO} - V_{N_2}$ ) to  $V_m N_2$  has been found to vary from 0.3 to 1.2 for different powders. This ratio gives the fraction of the surface occupied by the CO adsorbed in excess of  $N_2$  at  $-190.5^\circ\text{C}$ .

**8. Adsorption of Gases on Glass under Electrical Discharge.**

C. N. RAMACHANDRA RAO, Kharagpur.

The formation of a boundary layer when a gas is subjected to an electrical charge, due to chemisorption of excited particles and ions has been suggested by various workers. Studies on the influence of 'aging' under discharge at a constant applied potential support such a view. Aging not only decreases the conductivity, but also the threshold potential. This decrease in threshold potential during aging was observed in iodine vapour under electrodeless discharge, even in the presence of excess of solid iodine in the discharge tube and therefore could not have been due to fall in pressure due to adsorption. It might be because of the formation of an adsorption layer, probably of a low work function. Aging reduced the width of the non-self-maintained region and stabilized the discharge conditions. The influence of aging has been found to be more under conditions favourable for surface compound formation or chemisorption. The kinetics and the magnitude of the influence of aging as also the value of the threshold potential depend on the surface of the electrodes and the walls of the vessel. The decrease in conductivity with time follows an equation similar to that of Bangham for the adsorption of gases on glass (at least for lower values of time). The formation of the boundary layer is not only fundamental to aging but also to various other phenomena observed under electrical discharge. Naturally any such phenomenon will be affected by the slightest change in the surface conditions either of the electrodes or of the vessel.

**9. Ionophoresis of Purines and Pyrimidines from Yeast Nucleic Acid.**

S. N. MUKHERJEE, Jadavpur, Calcutta.

Results recorded in the literature for paper ionophoresis of purines and pyrimidines in different media in vertical and horizontal migration set-ups have been widely divergent as observed by different workers. Migration rates have been observed to be different, having nonlinear variation with time, and showing a 'mobility equilibrium'. These discrepancies prompted further investigation and it has been observed that reproducible results can be obtained in horizontal arrangement with a buffer medium of appropriate pH, with low current, (approx. 1 mA) which serves to eliminate the heating effect and consequent distillation of water and with frequent feeding arrangements to prevent convection or suction of the medium along the paper which serves to vitiate the results. Observations so far made point to a uniform migration throughout the entire length of the paper with no "mobility equilibrium", and varying almost linearly with time.

**10. Halogenation of Phenol with Iodine Bromide in Acetic Acid.**LOURDU M. YEDDANAPALLI, R. GANESAN and N. S. GNANAPRAGASAM,  
Madras.

Iodine bromide has been found, from a number of investigations carried out in the laboratory, to be a more convenient reagent than pure bromine in assessing the reactivities of aromatic compounds by halogenation, and has therefore been used for the study of the kinetics and mechanism of the bromination of phenol in a polar solvent like glacial acetic acid under different experimental conditions of temperature and concentrations of reactants. It has been found that the reaction, within the concentration range 0.1 to 0.005 M and temp. 20 to 40°C, is kinetically second order with respect to IBr and first order with respect to phenol, the



over-all order being three. The apparent energy of activation for the reaction is 9890 cal. per mole. A tentative mechanism has been proposed to account for the observed kinetic order and the activation energy of the reaction.

#### 111. Hydrogenation of Ethylene at 0°C on a cobalt catalyst.

V. RAMAKRISHNA and K. R. KRISHNASWAMI, Bangalore.

When a 1:1 mixture of  $H_2$  and  $C_2H_4$  is left in contact with a cobalt-silica catalyst at 0°C, ethylene is hydrogenated to the extent of 86%. The presence of CO in the gas phase reduces this conversion to 19%, while  $N_2$  does not interfere with the reaction. A direct correlation has been observed between these reactions and the adsorption of the gases from the binary mixtures on the catalyst at 0°C. Carbon monoxide diminishes the adsorption of  $H_2$  markedly, and does not influence the ethylene adsorption to any great extent. It is, therefore, concluded that the reaction under consideration proceeds mainly through chemisorbed hydrogen at the surface of the catalyst.

#### 112. Studies on Oxo reaction with Alicyclic compounds.

U. N. BHRANY and M. R. A. RAO, Bangalore.

Reaction of cyclohexene with synthesis gas ( $CO+H_2$ , 1:1) under pressures of 50–300 atms. and temperatures of 100–300°C in the vapour phase over Kieselguhr (Kg) supported cobalt, and cobalt iron catalysts, prepared under various conditions has been studied. At a temperature of 205°C and a pressure of 200 atms. using Co:Fe:Kg (30:1:70) catalyst, a liquid product is obtained which contains 59% cyclohexyl-carbinol, 30% cyclohexyl formaldehyde. Whereas with unpromoted cobalt catalyst the aldehyde predominates in the product (63.19% aldehyde and 18.46% alcohol). Effect of sulphur (a catalyst poison) indicates that the reaction is homogeneous in nature. Similar studies have also been carried out employing dipentene.

#### 113. Reaction between butyl alcohol and ammonia under pressure.

V. A. KRISHNA MURTHY and K. R. KRISHNASWAMI, Bangalore.

The reaction between butyl alcohol and ammonia under pressure using dehydration catalysts have been investigated. The effect of temperature, time, the ratio of ammonia to alcohol and the nature of preparation of catalyst have been worked out. An optimum conversion of 25% of the alcohol to the amines has been obtained at 300°C and 300 pounds per square inch pressure when the ratio of ammonia to alcohol is 6. The catalyst employed was precipitated alumina and the time of reaction was 2½ hours. The effect of hydrogenating catalysts on the reaction is also studied.

### ORGANIC CHEMISTRY

#### 114. p-Tolyl-Thiohydantoin and its derivatives and their use as analytical reagents

H. K. PUJARI, R. K. NANDA and M. K. ROUT, Cuttack.

In the present investigation p-tolyl-thiohydantoin has been prepared by reaction of p-tolyl-isothiocyanate with glycine and the resulting compound has been condensed with eleven different aldehydes and two nitroso compounds. All these compounds have been screened for use as analytical reagents. Metallic complexes were obtained with Cu, Hg and Ag ions,

**N-p-Tolyl Rhodanine and its derivatives.**

H. K. PUJARI and M. K. ROUT, Cuttack.

The present investigation deals with the preparation of N-p-tolyl rhodanine by reaction of p-tolyl ammonium dithiocarbamate with sodium monoacetate and its condensation products with aldehydes, ketones and nitroso compounds. The arylidene derivatives have been screened for use as analytical reagents. Coloured metallic complexes are formed with Cu, Ag and Hg salts. Estimation of these metals with the aid of one of the arylidene derivatives is in progress. The condensation products with aldehydes and ketones have also been found to possess appreciable fungicidal activity, the percentage of inhibition of spore germination being cent per cent even at 100 p.p.m. with some of the compounds.

**6. Studies on Thiazolidones. Part I.— $\alpha$ -Naphthyl-Imino 4-Thiazolidone and its condensation products and use of one of these in the estimation of silver**

BHASKAR DAS and M. K. ROUT, Cuttack.

The preparation of  $\alpha$ -naphthylimino 4-thiazolidone and its condensation with aldehydes, ketone, quinones and nitroso compounds has been described. The correctness of the structure assigned for the thiazolidone compound has been established by a series of reactions. One of the arylidene derivatives, 5-m-nitro-2- $\alpha$ -naphthylimino 4-thiazolidone has been used successfully for quantitative estimation of silver. Estimation of Hg and Cu with the aid of this reagent is in progress.

**7. Thiodiazolines. Part I—p-tolyl-imino thiodiazoline and its C-aryl derivatives.**

K. C. DAS and M. K. ROUT, Cuttack.

In the present investigation, seven new p-tolylimino-C-aryl thiodiazolines have been prepared from the corresponding benzal thiosemicarbazones by using two methods developed by us. Ten new p-tolyl (substituted benzal) thiosemicarbazones were used as intermediates in this synthesis and the parent compound, p-tolylimino thiodiazoline and some of its derivatives have also been prepared. The parent compound, p-tolylimino thiodiazoline has been examined for use as an analytical reagent.

**8. Thiazole Derivatives and their Fungicidal action. Part I—2-substituted-amino 4-5-dimethyl thiazoles.**

NABINKISHORE DAS, G. N. MOHAPATRA and M. K. ROUT, Cuttack.

The present communication describes the preparation of thirteen new 2-substituted-amino 4-5-dimethyl thiazoles prepared by reaction of ethyl methyl ketone with substituted thioureas in presence of  $I_2$  by our modified method already reported by Rout & Pujari, J.A.C.S., 1953, 75, 4057). These compounds have also been mercurated by treatment with mercuric acetate in acetic acid. The bactericidal and fungicidal activities of these compounds have been studied. With respect to Hg, the unmercurated thiazoles exhibited activity in maximum dilutions of 1:1,000, while the mercurated thiazoles were active in dilutions up to 1:75,000.



Using *Alternaria Polanduii* Ayyangar as the fungus indicator, the unmercurated thiazoles completely inhibited spore germination at a concentration of 100 parts per million. The mercurated thiazoles were much more powerful, being 100 per cent effective in inhibiting spore germination even at a concentration of 2 parts per million.

**119. 2-p-chloro-phenyl-imino 4-thiazolidone and its condensation products and their use as analytical reagents.**

H. K. PUJARI and M. K. ROUT, Cuttack.

In this paper, 2-p-chlorophenyl-imino 4-thiazolidone has been prepared by reaction of mono-chloroacetic acid with p-chlorophenyl thiourea in absolute alcohol in presence of anhydrous sodium acetate. When the reaction was carried out in rectified spirit, a compound soluble in water and acidic in nature was obtained which could not obviously be the thiazolidone compound. The thiazolidone compound and its condensation products with benzaldehyde and p-nitrosodimethylaniline give insoluble metallic complexes with Ag, Hg and Cu salts and this reaction is being utilised in the estimation of these metals.

**120. Thiophene Isosters of Carcinogenic Hydrocarbons.**

V. V. GHASIAS and B. D. TILAK, Bombay.

With the view to study the significance of an "activated phenanthrene bridge" in carcinogenic hydrocarbons, 4:10-dimethylthionaphthene(6:5-b)thionaphthene (I) and 6:12-dimethylbenzo(1:2-b, 4:5-b')dithionaphthene (II) were synthesized. These compounds are thiophene isosters of the carcinogenic hydrocarbons, 9:10-dimethyl-1:2-benzanthracene and 9:10-dimethyl-1:2:5:6-dibenzanthracene respectively.

Condensation of thioisatin with 2-bromoacetylthiophene gave 2-(2'-thienoyl)thionaphthene-3-carboxylic acid which was converted to (I) through the intermediate thionaphthene(6:5-b)thionaphthene-4:10-quinone. Compound (II) was similarly prepared starting from thioisatin and the hitherto unreported 3-bromoacetylthionaphthene.

**120A. Substituted Quinoline Acetic Acids.**

N. L. TIKOTKAR and S. N. KULKARNI.

o-Chloroaniline on heating with ethyl acetone dicarboxylate gave a dianilide M.P. 160°C cyclized to 2-hydroxy-8-chloro quinoline 4-acetic acid M.P. 233-234°C, decarboxylated to 2-hydroxy 4-methyl 8-chloro quinoline M.P. 253-254°C. The same compound was also prepared by heating ethyl acetoacetate and o-chloro-aniline at 160°C followed by cyclization by 80% sulphuric acid.

m-Chloro-aniline gave a dianilide M.P. 136°C cyclized to 2-hydroxy 7-chloro quinoline 4-acetic acid M.P. 248°C, decarboxylated by heat to 2-hydroxy 4-methyl 7-chloro quinoline M.P. 273°C. (Sandquist, J.C.S., 1951, 1038).

p-Chloroaniline gave dianilide M.P. 149-150°C cyclized to 2-hydroxy 6-chloro quinoline 4-acetic acid M.P. 244-245°C, decarboxylated to 2-hydroxy 4-methyl 6-chloro quinoline M.P. 260-261°C. The latter was also prepared by heating ethyl acetoacetate with p-chloro-aniline at 160°C followed by cyclization by sulphuric acid.

**Synthesis of some 2-methyl chromone—and flavone carboxylic acids.**

(Miss) SINDHU PARKHI and SURESH SETHNA, Baroda.

Attempts were made to acetylate and benzoylate methyl 2:4-dihydroxy-5-acetyl benzoate under the conditions of Kostanecki-Robinson reaction but only the ethyl and the monobenzoyl derivative respectively were obtained. The synthesis of 5-hydroxy-2-methyl chromone 6-carboxylic acid and 7-hydroxy flavone 6-carboxylic acid was however achieved by the Claisen condensation of methyl 2:4-dimethoxy-3-acetyl benzoate with ethyl acetate and ethyl benzoate and subsequent ring closure of the  $\beta$ -diketones formed. Similarly 5-hydroxy-2-methyl chromone 6-carboxylic acid has been synthesised by the Claisen condensation of methyl 2:4-dimethoxy-3-acetyl benzoate with ethyl acetate and subsequent ring closure of the  $\beta$ -diketone formed. Methyl 2:4-dihydroxy-3-acetyl benzoate unlike the 5-acetyl benzoate undergoes Kostanecki-Robinson acetylation and gives 5-hydroxy-2-methyl chromone 6-carboxylic acid and 5-hydroxy-2-methyl-3-acetyl chromone 6-carboxylic acid. The work on the benzoylation of methyl 2:4-dihydroxy-3-acetyl benzoate is in progress.

**2. Studies in Hydroxyanthracene derivatives. Part I, Reactions of 1-anthrol.**

S. S. LELE, N. H. SHAH and SURESH SETHNA, Baroda.

1-Anthrol on Pechmann condensation with ethyl acetoacetate gave 4'-methyl-1-anthra- $\alpha$ -pyrone. On Friedel and Crafts acetylation of 1-anthrol, 2-acetyl-1-anthrol was obtained in poor yield. The same product was obtained in Fries rearrangement at 140° of 1-anthrol acetate. In the Gattermann reaction 1-anthrol gave exclusively 4-formyl derivative in very good yield.

**3. Synthesis of 4-hydroxycoumarin derivatives.**

N. J. DESAI and SURESH SETHNA, Baroda.

4-Hydroxycoumarin derivatives have assumed considerable importance in recent years as they serve as the starting materials for the synthesis of dicoumarols which are anticoagulants for blood. 4:7:8-Trihydroxy- and 4:7-dihydroxy-5-methylcoumarin have been synthesised by the condensation of cyano-acetic ester in presence of dry hydrogen chloride with pyrogallol and orcinol respectively. 4-Hydroxy-6-methoxy-, 4-hydroxy-7:8-dimethoxy- and 4-hydroxy-7-methoxy-5-methylcoumarin have been synthesised by condensing ethyl carbonate with monomethylether of quinacetophenone, dimethylether of gallacetophenone and monomethylether of cacotophenone respectively in presence of sodium metal. The above coumarins have been condensed with formaldehyde and the dicoumarols obtained. On treatment with pyridine acetic-anhydride the dicoumarols gave the dehydrated products. 4:7-Dimethoxy- and 4:7:8-trimethoxycoumarin on Elb's persulphate oxidation gave 2:5-dihydroxy-4-methoxy- and 2:5-dihydroxy-3:4-dimethoxyacetophenone respectively instead of the expected 6-hydroxycoumarin derivatives. 4:7-Dimethoxy- and 4:7:8-trimethoxycoumarin on heating with dilute hydrochloric acid gave 4-hydroxy-7-methoxy- and 4-hydroxy-7:8-dimethoxycoumarin respectively.

**4. Synthesis of 2,4'-dimethyl-8'-acetyl-6'-7'-furocoumarin.**

H. K. PENDSE and S. D. LIMAYE, Poona.

The first synthesis of a member of the furocoumarin class was effected by B. Limaye (1932), starting from Fries transformation product of a hydroxy-



coumarin. Now a furocoumarin has been obtained by using a Claisen transformation product of an allyloxy-coumarin, viz. 7-hydroxy-8-acetyl-6-allyl-4-methyl-coumarin (I). 7-Acetoxy-8-acetyl-6-allyl-4-methyl-coumarin (II), m.p. 115°, obtained from (I) by acetylation, was brominated to give 7-acetoxy-8-acetyl-6-( $\beta$ - $\gamma$ -dibromopropyl)-4-methyl-coumarin (III), m.p. 101°,  $C_{17}H_{16}O_5Br_2$ . This on treatment with caustic alkali gave 2-hydroxy-3-acetyl-4:5-(2'-methyl-furo)- $\beta$ -methyl-cinnamic acid (IV), m.p. 160°,  $C_{15}H_{14}O_5$ . On heating to its melting point (IV) gave 2-4'-dimethyl-8'-acetyl-6'-7'-furo-coumarin (V), m.p. 165°,  $C_{15}H_{12}O_4$ . (IV) was regenerated from (V) by the action of caustic alkali. The elimination of a molecule of water by the action of heat on (IV) indicated its nature as a stable cis acid. (cf. Limaye and Sathe, 1936). (IV) and (V) gave, by the action of decinormal sodium hydroxide, 2-hydroxy-3-acetyl-4:5-(2'-methyl-furo)-isopropylene benzene (VI), m.p. 86°,  $C_{14}H_{14}O_3$  formed by the decarboxylation of the unisolable trans isomer of (IV). On bromination (I) gave 7-hydroxy-8-acetyl-6-( $\beta$ - $\gamma$ -dibromopropyl)-4-methyl-coumarin (VII), m.p. 145°,  $C_{15}H_{14}O_4Br_2$ , which on treatment with caustic alkali gave (IV) which further yielded (V). Acetylation of (VII) gave (III).

### 125. Substituted Quinoline Acetic Acids—Part I.

S. N. MUNVALLI and K. S. NARGUND, Dharwar.

o-Toluidine when heated at 150°C with ethyl acetone dicarboxylate gave a mono-toluidide M.P. 122-23°C which on heating with 80% sulphuric acid on a water bath gave 2-hydroxy-8-methyl quinoline 4-acetic acid M.P. 200-201°C. The constitution was proved by decarboxylation when it gave 2-hydroxy 4:8 dimethyl quinoline M.P. 216-217°C. (Knorr, B. 17, 542; A. 245, 368; Ewins and King Soc. 103, 1913).

m-Toluidine on heating with ethyl acetone dicarboxylate gave a mono-toluidide M.P. 135°C which could be cyclized by 80% sulphuric acid to yield 2-hydroxy 7-methyl quinoline 4-acetic acid M.P. 207-208°C, decarboxylated by heat to 2-hydroxy 4:7 dimethyl quinoline M.P. 218°C. (Knorr, A 245, 370).

p-Toluidine under similar conditions gave a ditoluidide M.P. 168-168°C (Naik, J.C.S., 1921, 1240) cyclized to 2-hydroxy 6-hethyl quinoline 4-acetic acid M.P. 239-240°C, decarboxylated to 2-hydroxy 4:6 dimethyl quinoline M.P. 246-247°C (Knorr, B. 17, 541; A. 245, 365).

### 126. Condensation of Glycol mono-ethers of Phenol and Cresols with Succinic anhydride.

I. S. SHENOLIKAR and K. S. NARGUND, Dharwar.

For the purpose of preparing  $\gamma$  phenyl butyro lactones with a hydroxy alkoxy group as a substituent in the phenyl nucleus the condensation of Glycol mono-ethers of Phenol and Cresols with Succinic anhydride by Friedel and Craft's Reaction has been attempted.

Glycol mono-phenyl ether gave  $\beta$  (p  $\beta$  hydroxy ethoxy benzoyl) propionic acid, M.P. 65°. The constitution of the acid was proved by oxidation by alkaline Potassium Permanganate to p-carboxy phenoxy acetic acid, M.P. 275°.

Glycol mono 'O' Cresol ether gave  $\beta$  (3 Methyl 4  $\beta$  hydroxy-ethoxy benzoyl) propionic acid, M.P. 55°. To prove its structure oxidation was not successful. But it could be easily converted to  $\beta$ -3-Methyl-4-hydroxy benzoyl propionic acid, M.P. 184°, by HBr in Acetic acid. Cf. Rosenmund and Schapiro. (Arch. Pharm., 1934 272, 313).

Glycol mono 'M' Cresol ether gave  $\beta$  (2 Methyl 4  $\beta$  hydroxy ethoxy benzoyl) propionic acid, M.P.  $47^{\circ}$ , which was converted by HBr into  $\beta$ -2-Methyl-4-hydroxy benzoyl propionic acid, M.P.  $172^{\circ}$ . Cf. Raval, Bokil and Nargund (Jour. Bom. Chi. 1938 vol. VII, part 3, 184).

Glycol mono 'P' Cresol ether gave a keto acid, M.P.  $85^{\circ}$ , the constitution of which is under investigation.

All the above acids have been characterised by the preparation of suitable derivatives such as Semicarbazones, Methyl and Ethyl esters.

## 27. Preparation of dichloro propiophenones and $\beta$ -dichloro phenyl propionic acids.

V. V. DEVASTHALE and K. S. NARGUND, Dharwar.

Dichloro benzenes were condensed with propionyl chloride by Friedel and Crafts's reaction using the conditions described by Shodhan, Kshatriya and Nargund. (I.C.S. 24, 373, 1947).

3:4 dichloro propiophenone (96% yield), b.p.  $267-270^{\circ}$ , m.p.  $44^{\circ}$ , formed an oxime, m.p.  $121^{\circ}$  and a semicarbazone, m.p.  $212^{\circ}$ .

2:4-dichloro propiophenone (92% yield), b.p.  $255-257^{\circ}$ , formed an oxime, m.p.  $105^{\circ}$ , and a semicarbazone, m.p.  $189^{\circ}$ .

2:5 dichloro propiophenone (38% yield), b.p.  $255-260^{\circ}$ , formed an oxime, m.p.  $106^{\circ}$ , and a semicarbazone, m.p.  $191^{\circ}$ .

The constitutions of the dichloro propiophenones were proved by oxidation to the corresponding dichloro benzoic acids. Kindler's modification of the Willgerodt's reaction on these ketones gave  $\beta$ -dichloro phenyl propionic acids, in yields of about 20 to 30 per cent. Thus  $\beta$ -3:4 dichloro phenyl propionic acid, m.p.  $71^{\circ}$ ,  $\beta$ -2:4 dichloro phenyl propionic acid, m.p.  $74^{\circ}$ , and  $\beta$ -2:5 dichloro phenyl propionic acid, m.p.  $92^{\circ}$ , have been prepared.

## 28. Synthesis of Dihydro Flavonols and Flavonols—Part III : Synthesis of Naphtha Dihydroflavonol.

M. G. MARATHEY, Poona.

The effects of 5':6'- and 3':4'-substitutions in an o-hydroxy or o-acetoxy-chalkone or the corresponding chalkone dibromides on the formation of dihydroflavonols and flavonols have been discussed. It has been shown that 2'-hydroxy-5':6'-benzo-4-methoxy-chalkone m.p.  $120^{\circ}$ , does not yield the corresponding flavonol when subjected to the Alger and Flynn oxidation and only the corresponding flavanone is obtained. Similarly, the corresponding o-acetoxy-chalkone dibromide when subjected to the action of aqueous acetone and alkali does not give the corresponding flavonol but gives the corresponding flavone and benzal coumarone when treated with cold and hot alcoholic alkali respectively.

It has been shown in that 2'-acetoxy-3':4'-benzo-4-methoxy-chalkone dibromide gives various intermediate products viz.  $\beta$ -hydroxy-derivative, the chalkone oxide, the dihydroflavonol, all of which give the corresponding flavonol.

Similarly, the effect of the substitution of a 5'-carboxylic group in a chalkone was not found to change the course of the reactions and the corresponding dihydroflavonol and the flavonol could be obtained by both the Alger and Flynn oxidation of chalkone and by the action of aqueous acetone and alkali on the chalkone dibromide.



These results show that the mechanism of the formation of a flavonol from a chalcone by the action of alkaline hydrogen peroxide and from a chalcone dibromide by the action of aqueous acetone and alkali is similar and both the reactions proceed stepwise.

### 129. Synthesis of Dihydroflavonols and Flavonols. Part IV: Synthesis of bromo-flavonols.

M. G. MARATHEY and K. G. GORE, Poona.

The present work deals with the direct synthesis of a  $\beta$ -hydroxy-derivative, which is an essential intermediate step in the formation of a dihydroflavonol and a flavonol from a chalcone dibromide.

2'-Hydroxy-5'-methyl-4-methoxy-chalcone when brominated with 2 moles of bromine in dilute acetic acid gives the corresponding  $\alpha$ -bromo- $\beta$ -hydroxy-derivative when simultaneous ring bromination takes place. That ring bromination has taken place is confirmed by first brominating the 2-hydroxy-5-methyl-acetophenone when 2-hydroxy-3-bromo-5-methyl-acetophenone is obtained which when condensed with anisaldehyde gives the bromo chalcone and the bromo chalcone-dibromide when treated with aqueous acetone gives the  $\beta$ -hydroxy-derivative obtained by the first method.

This  $\beta$ -hydroxy-derivative cyclises to the corresponding dihydroflavonol which in its turn gives the flavonol with alkali. The structures of the dihydroflavonol and the flavonol are confirmed by their synthesis from the bromo-chalcone by Ager and Flynn oxidation reaction.

The bromo-chalcone dibromide gives the corresponding flavonol and the benzal coumaranone with cold and hot alcoholic alkali respectively.

### 130. Synthesis of 4-methyl-6-ethyl-2'-phenyl coumarin-7:8- $\gamma$ -pyrone.

M. G. MARATHEY and K. G. GORE, Poona.

On condensing 4-methyl-6-ethyl-8-acetyl-umbelliferone, m.p. 137°, with benzaldehyde, the chalcone, 4-methyl-6-ethyl-7-hydroxy-coumarin-8-styryl-ketone, m.p. 145°, I, was obtained. Acetate, m.p. 138°; Benzoate, m.p. 154°. The chalcone, m.p. 145°, I, when refluxed with alcoholic hydrochloric acid gave the corresponding flavanone, m.p. 172°, II. If the reaction mixture was acidified after 5 days, 2:4-dihydroxy-(3-cinnamoyl)-5-ethyl- $\beta$ -methyl-cinnamic acid, m.p. 179°, III, which lost CO<sub>2</sub> on heating was obtained. Equivalent weight found=348; C<sub>21</sub>H<sub>20</sub>O<sub>5</sub> requires=352.

However, the chalcone on cold hydrolysis gave another acid IV, which did not melt sharp, and regenerated the original chalcone on heating up to its melting point, which is probably a-cis-acid corresponding to III.

The acetate m.p. 138° of the chalcone, m.p. 154° I, on bromination (1 mol.) gave 4-methyl-6-ethyl-7-acetoxy-coumarin-8-( $\alpha$ : $\beta$ -dibromo)-phenyl-ethyl-ketone, m.p. 192°, V. The bromide, m.p. 192°, V, when treated with alcoholic alkali gave 4-methyl-6-ethyl-2'-phenyl-coumarin-7:8-pyrone, m.p. 284°, VI. The flavone, m.p. 284°, VI, on cold alkali hydrolysis gave 2-hydroxy-(3:4-flavono)-5-ethyl- $\beta$ -methyl-cinnamic acid, VII, which regenerated the original flavone, VI, on (a) heating up to its melting point, (b) crystallisation from alcohol and acetic acid.

Equiv. wt. found=331.8  
C<sub>21</sub>H<sub>18</sub>O<sub>5</sub> required=350

The chalcone, m.p. 145°, I, on oxidation with alkaline hydrogen peroxide gave 4-methyl-6-ethyl-2'-phenyl-3-hydroxy-coumarin-7:8- $\gamma$ -pyrone, m.p. 245°, VIII, and the corresponding trans- $\beta$ -methyl-cinnamic acid, m.p. 228°, IX.

### 31. Synthesis of Dihydro Flavonol and Flavonols. Part V: Synthesis of 5:6-substituted flavonols.

M. G. MARATHEY, J. M. A'THAVALÉ and K. G. GORE, Poona.

The effect of different 5':6'-substitutions in a chalcone on the synthesis of flavonols by Alger and Flynn oxidation has been discussed here.

In part III of this series the effect of a 5'-6'-benzo substitution was found to hinder the formation of flavonols. With a 6':5'- $\alpha$ -pyro-substitution the yield of the flavonol is 20% when the corresponding trans- $\beta$ -methyl-cinnamic acid is also obtained in small yields. However, with a 6':5'-furano-substitution, the reaction runs smooth and the yield of the flavonol is more than 50%.

Thus, it has been found that the effect of a substitution in 6' or 5':6'-position in a chalcone on the course of the reaction varies with the nature of the substitution. The results can be summarised as follows:

6'-methoxy	—benzal coumaranone and traces of flavonol.
5':6'-benzo	—no flavonol.
6':5'- $\alpha$ -pyrono	—20% flavonol.
6':5'-furano	—50% flavonol.

### 132. Synthesis of cyanine dyes by the condensation of p-dialkylaminobenzaldehyde with appropriate heterocyclic compounds. Part VI.

M. Q. DOJA and ARUN KUMAR SINHA, Patna.

p-Dimethylamino- and p-diethylamino-benzaldehydes have been condensed with 6-chloro-, 6-bromo-, 6-iodoquinaldine ethiodide and 6-formamido-, 6-acetamido quinaldine ethiodide respectively. The effect on sensitization of substitution in the quinaldine nuclei of p-diethylamino- and p-dimethylamino cyanines has been studied. The optical, chemical, dyeing and photographic properties of these compounds have been examined and a few intermediates have been described.

### 133. Isolation of the Chromate-Diphenylcarbazide Reaction Product—an attempt.

MONISHA BOSE, Calcutta.

In connection with our work on the mechanism of the chromate-diphenylcarbazide colour reaction (Bose, Anal. Chim. Acta, 1954, 10, 201 & 209) attempts were made to isolate the red-violet chromium compound in a state of purity separately from (a) chromate-diphenylcarbazide and (b) chromous-diphenylcarbazone systems since both gave identical products. The solid product from the acidified chromate-carbazide reaction mixture (A) was found to have the same absorption spectrum (max. at 540m $\mu$ ) as that of the red-violet complex in solution. However, analysis of the freshly precipitated product did not conform to the theoretical value for the 1:1 chromous-carbazone complex, the Cr:N ratio being less than 1:4. The compound contained coordinated water molecules as the vacuum dried product (over H<sub>2</sub>SO<sub>4</sub>) on heating gave out water. When freshly precipitated the product though not highly soluble readily dissolves in various organic solvents but on keeping gradually becomes more and more insoluble. The compound is quite stable in the solid state and in alcoholic solution in absence of acids the colour intensity is almost unchanged for 2-3 days. Presence of acids, however, causes comparatively rapid destruction of colour.

In case of the product from chromous-carbazone mixtures, repeated crystallisation from alcoholic solution failed to free the product from the accompanying excess of the reagent carbazone.

The product when finally subjected to chromatographic adsorption analysis employing column, as well as, paper-partition techniques indicated the presence of



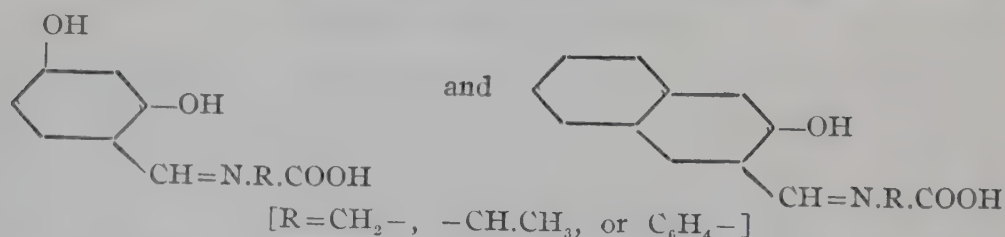
2 components in the violet complex prepared, one strongly adsorbed (not elutable with ordinary organic solvents), the other not adsorbed at all. The latter with time, however, is again partially converted to the adsorbed component. This explains the difficulty of isolating the more soluble component in the pure state. The less soluble adsorbed component prepared from the original product by repeated washing out of the more soluble unadsorbed component with alcohol, on analysis indicated a further increase in the chromium content with a corresponding decrease in the  $N_2$  content as compared to the original product. This indicates gradual conversion of the violet product to its hydrolysed and polymerised form. Thus the phenomenon of hydrolysis and condensation so prevalent in chromium chemistry also plays a predominant role here.

Finally the exceptional stability of the chromous-carbazone complex deserves mention.

#### 134. Inner-Metallic Complex Salts of o-Hydroxyaldimino Acids with Polycyclic Rings.

AJIT KUMAR MUKHERJEE, Calcutta.

In previous papers (Rây and Mukherjee, J. Indian Chem. Soc., 27, 707, 1950; Proc. Indian Sci. Cong. Abst. III, 1952, 49-50; *ibid.*, III, 1954, 54-55), polycyclic inner-metallic complexes of copper, nickel, cobalt, manganese, iron, uranium and vanadium with salicylaldimino acid and with p-aminophenylsulphonamide and its derivatives have been described. In continuation thereof it has now been possible to prepare and study a number of similar metal chelate complexes of copper, nickel, cobalt and manganese with Schiff's base derived from resorcyaldehyde or o-hydroxynaphthaldehyde and different amino acids like glycine, alanine and anthranilic acid. The configuration of these complexes could not always be represented by unique and unambiguous structural formula. The o-hydroxyaldehyde molecules in these complexes are believed to undergo condensation with amino-acids giving rise to what may be termed as 'aldimino-acids' which can both function as tridentate and bidentate ligand under suitable conditions.



The compound could also be prepared in aqueous alcoholic medium using acetate of the metals, corresponding amino-acids and the hydroxyaldehydes.

The magnetic susceptibilities of these compounds were measured at the room temperature with the help of Gouy's balance. Copper, nickel, cobalt and manganese compounds were all found to be paramagnetic, with moment values of 1.79-1.81, 2.77-3.13, 1.55-4.49 and 5.80-6.05  $\mu_B$  respectively. The copper- $\beta$ -hydroxynaphthaldehyde, however, shows a moment value of 2.05  $\mu_B$  indicating its ionic character or a structure with  $Sp^2d$  planar bonds, (Rây and Sen, J. Indian Chem. Soc. 25, 473, 1948). The cobaltous complexes gave, however, different magnetic values. Cobalt resorcyaldehyde-alanine and cobalt- $\beta$ -hydroxynaphthaldehyde glycine give the moment values of 2.02 and 1.58  $\mu_B$  respectively, corresponding practically with the spin moment of one unpaired electron. These substances may, therefore, be regarded as penetration complex with  $dsp^2$  square planar bonds. All the nickel and the manganese compounds show paramagnetic values of near about 3 and 6  $\mu_B$  respectively corresponding to those of simple nickelous and manganeseous

s. Hence these metal chelates complexes are of the weak covalent type resonating with ionic ones.

#### 5. A new Method for the Oxidation of 2:2'-dibenzoyloxy-4:4'-dinitrodiphenyl sulphide to the corresponding Sulphone.

H. G. BISWAS, Calcutta.

In place of oxidizing a boiling acetic acid solution of the sulphide with excess 30% hydrogen peroxide a warm solution of the sulphide in acetic acid has been oxidized at room temperature with the help of potassium dichromate in dilute sulphuric acid. The heat of reaction is sufficient to oxidize the sulphide into the corresponding sulphone giving satisfactory yield of the pure product with concomitant economy in time and material.

#### 6. The Structure of Grifolin.

A. K. BOSE and B. G. CHATTERJEE, Kharagpur.

The ultra-violet and infra-red spectra of the anti-biotic grifolin obtained from the Basidiomycete *Grifola confluenta* have been studied. The structure proposed for grifolin by Hirata and Nakanishi has been found to be incompatible with these spectra. The correctness of the formula  $C_{16}H_{28}O_2$  assigned to grifolin also seems to be open to doubt.

For grifolin the formula  $C_{16}H_{26}O_2$  and a new structure are now proposed. The calculated value of the ultra-violet absorption maximum, 278 m $\mu$ , is in close agreement with the observed value of 275 m $\mu$ . Products obtained on oxidation of grifolin can be easily accounted for on the basis of the new structure.

#### 7. Synthesis of a Thiophene Analogue of 3-Desoxyequilenin.

R. B. MITRA and B. D. TILAK, Bombay.

In continuation of our study of the role which an activated 9:10-double bond phenanthrene plays in chemical carcinogenesis synthesis of thiophene analogues of sterols has been undertaken.

Synthesis of 3:4-(1'-keto-2'-methyl-2':3'-cyclopentano)-1:2:3:4-tetrahydrodibenzothiophene (I), a thiophene analogue of 3-desoxyequilenin, starting from 4-keto-2:3:4-tetrahydrodibenzothiophene (II) by a six-step synthesis is under way. The synthesis is analogous to Johnson *et al.*'s synthesis of 3-desoxyequilenin starting from 1-keto-1:2:3:4-tetrahydrophenanthrene (*J.A.C.S.*, 1947 69, 2942).

Compound (II) was converted to 3:4-(4'-carbethoxy-1'-2':3'-keto-2'-methyl-3'-cyclopentenol-1:2:3:4-tetrahydrodibenzothiophene (III) in four steps in an overall yield of 48%. Conversion of the latter to (I) in 2 steps is in progress.

#### 8. Reaction of Phenylmagnesium bromide with 3-Phenyl-4(3H)-Quinazolone.

I. K. KACKER and S. H. ZAHEER, Hyderabad-Dn.

Koelsch (*J. Amer. Chem. Soc.*, 1945, 67, 1718) reported the isolation of N-( $\beta$ -phenylisopropyl)-anthranilamide (1) from the reaction of 3-phenyl-4(3H)-quinazolone with benzylmagnesium chloride. Sen and coworkers (*J. Indian Chem. Soc.*, 1948, 25, 437; *ibid.*, 1950, 27, 40) reacted 2-methyl-3-substituted-4-(3H)-quinazolones with aryl or alkylmagnesium halides and reported that no fission of the heterocyclic ring of the quinazolone takes place and the products of the reactions are 3,4-dihydro-3,4-tri-substituted-4-hydroxyquinazolines. The present authors repeated the work of Koelsch and confirmed his findings. The reaction was further extended, and



it was established that product of the reaction of 3-phenyl-4(3H)-quinazolone with phenylmagnesium bromide was N-(diphenylmethyl)-anthranilamide (II) m.p. 174–76°C. II, on hydrolysis with potassium hydroxide in glycol solution, yielded N-(diphenylmethyl)-anthranilic acid (III), m.p. 192–94°C, and aniline. III could be synthesised by the reaction of anthranilic acid with diphenylmethylchloride. II was obtained by, first, treating III with thionyl chloride and then condensing with aniline.

### 139. Studies on 3-O-Tolyl-2-O-Tolylimino-4-Thiazolidone.

P. N. BHARGAVA and C. L. KAUL, Banaras.

3-O-Tolyl-2-O-tolylimino-4-thiazolidone has been synthesised from S-di-O-tolyl-thiourea and monochloroacetic acid in the presence of anhydrous sodium acetate and absolute alcohol. S-di-O-tolyl-thiourea has been prepared from O-toluidine and carbon disulphide. During studies on the effect of reaction conditions on the preparation of 3-O-tolyl-2-O-tolylimino-4-thiazolidone, the best yield is obtained by employing the amount of monochloroacetic acid slightly in excess than the required molar proportion and refluxing the reaction mixture for nearly 3 hours. Heating beyond 5 hours results in the resinification of the thiazolidone. The thiazolidone decomposes quantitatively into S-di-O-tolylurea on boiling with alkali. On treatment with acid it hydrolyses into the corresponding thiazolidone. It condenses with a number of aldehydes and ketones showing the presence of an active methylene grouping and also with semicarbazide hydrochloride, phenylhydrazine and 2:4-dinitro phenylhydrazine indicating the presence of a keto group. On oxidation with chromic anhydride the thiazolidone yields the sulphone derivative. All the above results establish the constitution of the compound which is further supported by its method of preparation.

### 140. Studies on 3-p-tolyl 2-p-tolylimino-4-thiazolidone.

P. N. BHARGAVA and B. CHITTEYYA, Banaras.

3-p-Tolyl-2-p-tolylimino-4-thiazolidone has been obtained by condensing monochloroacetic acid and S-di-p-tolyl thiourea which has been obtained by using  $\text{Na}_2\text{CO}_3$  or NaOH for eliminating  $\text{H}_2\text{S}$  evolved in the reaction and by refluxing the reaction mixture for one hour in the case of  $\text{Na}_2\text{CO}_3$  (74.2%) and for one and half hours in the case of NaOH (80%). The best yield of 3-p-tolyl-2-p-tolylimino-4-thiazolidone is got by refluxing the reaction mixture for 8 hours (97%). Thiazolidone decomposes quantitatively into S-di-p-tolyl urea on boiling with KOH. On treatment with HCl gas it gives thiazolidone hydrochloride. On condensation with acetone, 5-substituted thiazolidone is obtained in a crystalline form thereby showing the presence of an active methylene group. The above results established the constitution of the compound.

### 141. Studies on 3-m-tolyl-2-m-tolylimino-4-thiazolidone.

P. N. BHARGAVA and G. C. GOSWAMI, Banaras.

3-m-Tolyl-2-m-tolylimino-4-thiazolidone has been synthesised from S-di-m-tolyl-Thiourea and monochloroacetic acid in presence of anhydrous Sodium Acetate and absolute alcohol. S-di-m-tolyl-thiourea has been prepared from m-toluidine and carbon-disulphide.

**42. Studies on 3-m-tolyl-2:4-thiazolidione.**

P. N. BHARGAVA and A. JOGI PANTULU, Banaras.

3-m-Tolyl-2:4-thiazolidione has been synthesised from S-di-m-tolyl thiourea and monochloroacetic acid using glacial acetic acid or absolute alcohol as the solvent. di-m-tolyl thiourea has been prepared from m-toluidine and carbon disulphide using absolute alcohol as the solvent. During studies on the effect of reaction conditions on the preparation of 3-m-tolyl-2:4-thiazolidione, it has been found that the solvent has no effect on the formation of the compound and that the best yield is obtained by employing the amount of monochloroacetic acid slightly in excess than the required molar proportion and refluxing the reaction mixture for 3 hours.

**43. Studies on 3-p-tolyl-2:4-thiazolidione.**

P. N. BHARGAVA and M. SRINIVASA SASTRY, Banaras.

3-p-Tolyl-2:4-thiazolidione has been synthesised from S-di-p-tolyl thiourea and monochloroacetic acid using glacial acetic acid or absolute alcohol as the solvent. di-p-tolyl-thiourea has been prepared from p-toluidine and carbon disulphide using absolute alcohol as the solvent. During studies on the effect of reaction conditions on the preparation of 3-p-tolyl-2:4-thiazolidione, it has been found that the solvent used has no effect on the formation of the compound and that the best yield is obtained by employing the amount of monochloroacetic acid slightly in excess than the required molar proportion, and refluxing the reaction mixture for 6-6.25 hours (yield 30.02%). It has been observed that refluxing the reaction mixture beyond 6.25 hours results in the low yield of the required product.

**44. Preparation of S-di-o-tolyl thiobarbituric Acid.**

P. N. BHARGAVA and C. N. VASUDEVAN NAMBURY, Banaras.

S-di-O-Tolyl Thiobarbituric acid has been synthesised by condensing malonic acid with S-di-O-tolyl thiourea in presence of acetyl chloride. Its isonitroso compound has been found to be a good reagent in inorganic analysis, as the derivatives obtained with different metals are highly coloured and crystalline.

**45. Preparation of Thiazolidones and their 5-p-sulphonamido-phenylazo derivatives.**

G. N. MAHAPATRA and M. K. ROUT, Cuttack.

Fifteen different 2-arylimino-4-thiazolidones have been prepared by two methods. In the first method, the reaction was effected between aryl thioureas and monochloroacetic acid in absolute alcohol in presence of anhydrous sodium acetate while in the second, sodium ethoxide in absolute alcohol was used as the condensing agent and the reactants were ethyl monochloroacetate and aryl thioureas. The yields obtained by both the methods have been compared. The resulting thiazolidone compounds have been coupled with diazotised sulphanilamide, giving rise to fifteen different 5-sulphonamido-phenylazo derivatives. Rigid experimental evidence has been adduced to support our observation that the azo group is linked to the  $\text{CH}_2$ -group in 5-position of the thiazolidone nucleus. The azo derivatives have been tested for bactericidal action.



**146. Some derivatives of 2-arylimino-4-thiazolidones.**

G. N. MAHAPATRA and M. K. ROUT, Cuttack.

Fifteen aryl substituted (such as phenyl, o, m, p tolyl, o, m, p nitrophenyl, o, m, p chlorophenyl, o, m, p carboxyphenyl, and (naphthyl)-2-imino 4-thiazolidones prepared earlier have been mercurated with help of mercuric acetate and the position of the acetoxy mercuri group in the molecule has also been ascertained. Chloro and bromo mercuri derivatives of the above thiazolidones have also been prepared. The mercurated compounds have been tested against certain pathogenic bacteria such as *E. Coli* and *staphylococcus aureus* and the compounds have been found active in 1:40,000 dilutions in case of acetoxy mercuri compound and in 1:100,000 dilutions in case of chloro mercuri compounds. The bromo mercuri compounds are found to be more active than the either two. The fungicidal activity of these mercurated compounds has also been observed. *Alternaria Polanduii* Ayyangar has been used as the test fungus. The compounds are active at dilutions from two to six parts per million.

**147. Studies on the Preparation of Monoglycerides : Direct esterification of fatty acids and glycerol.**R. BASU ROY CHOUDHURY, D. GANGULY, SAMIR SARKAR and  
M. N. GOSWAMI, Calcutta.

The present investigators have studied the rate of esterification of different fatty acids of varying chain length with glycerol, the effect of temperature, time and alkali catalyst on the rate of reaction and on the proportion of the resulting mono-, di-, and triglycerides. It has been found that during the initial reaction period, the acid value falls apparently to the formation of more of triglyceride than of partial ester. As the reaction proceeds, due to effective stirring, presence of soap (formed out of the catalyst and fatty acid) and high reaction temperature the glycerol becomes more miscible with the glyceride mixture and as the free fatty acid gradually falls in concentration, the esterification at this stage assumes a reaction between triglyceride and glycerol and diglyceride and glycerol. The first type of reaction results in the formation of mainly diglycerides, in which stage a further concentration of diglyceride is increased and in presence of excess glycerol, an equilibrium is established between mono and diglyceride though in the final stage the monoglyceride percentage slightly predominates. This equilibrium is dependent upon the chain length of the fatty acids.

**148. Condensation of aniline with ethylacetoacetate.**

(Miss) D. D. VAGHANI and V. M. THAKOR, Bombay.

Aniline has been condensed with ethylacetoacetate in presence of phosphorus pentoxide. The main product was a phosphorus containing brown oil, which on successive treatment with boiling sodium hydroxide solution and boiling hydrochloric acid gave two products, one having m.p. 257° and the other having m.p. 246°-47° respectively.

The ether extract of the aqueous layer gave two other products, one having m.p. 98°-99° and the other having m.p. >300°. The aqueous layer on concentration gave brown oil and some solid of m.p. 233°-34°.

**9. Friedel Crafts reaction on Peonol and Monomethyl ether of Methyl- $\beta$ -resorcylic.**

MISS D. B. JHAVERI and V. M. THAKOR, Bombay.

Peonol on the Friedel Crafts acetylation gave three products : 4:6-diacetylresorcinol, 2:4:6-triacetylresorcinol and 2:4-diacetylresorcinol, 1-methyl ether.

The formation of the  $\gamma$ -product in peonol thus indicates that the methoxy group does not have steric effect on this position but that it is the internal hydrogen bond formation that activates the  $\gamma$ -position. The  $\gamma$ -product is not formed and only  $\beta$ - is obtained in case of isopeonol, as no such internal hydrogen bond formation can take place.

Similarly, on Friedel Crafts benzylation of peonol two products m.p. 167-168° and m.p. 134° have been isolated.

The Friedel Crafts acetylation of the 1-methyl ether of the methyl  $\beta$ -resorcylic is also been carried out when three products—methyl 2:4-dihydroxy-5-acetylbenzoate m.p. 122°, another with m.p. 114-115° and finally 2:4-dihydroxy-5-acetylbenzoic acid m.p. 233° have been isolated. The work on the constitution of the products and study of other reactions is in progress.

**50. Studies in Walden inversion : Kinetics of the conversion of 1-Bromo succinic acid to d- $\beta$  malo lactonic acid (Part I) ; and Hydrolysis of d- $\beta$ , malo lactonic acid to 1- or d- malic acid (Part II).**

J. C. GHOSH and M. S. MUTHANA, Kharagpur.

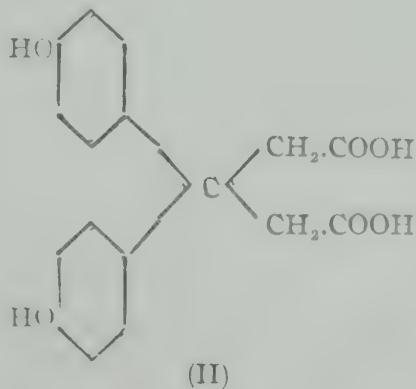
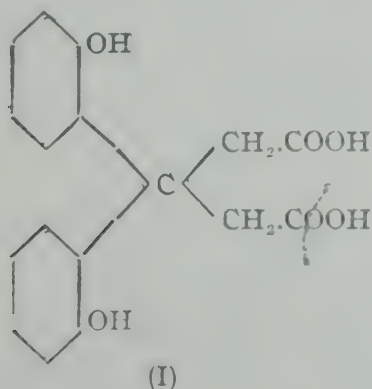
*Part I:* Kinetics of the conversion of 1-Bromo succinic acid to d- $\beta$  malo lactonic acid with various bases and at different pH were investigated. Conversions invariably followed monomolecular course. Up to pH 8, hydrolysis of the lactonic acid is negligible, while above 9.6 pH, rapid hydrolysis occurs to give dextro optatory malic acid.

*Part II:* Kinetics of the hydrolysis of d- $\beta$  malo lactonic acid obtained from 1-Bromo succinic acid have been studied. Acid hydrolysis follows bimolecular course with inversion of configuration of malic acid formed, while alkaline hydrolysis follows monomolecular course, malic acid formed retaining almost completely the configuration of the lactonic acid. A possible mechanism of the configurational changes is given.

**51.  $\beta\beta$ -Diaryl glutaric acid from phenol.**

V. M. DIXIT and B. R. RAVIKIRAN, Dharwar.

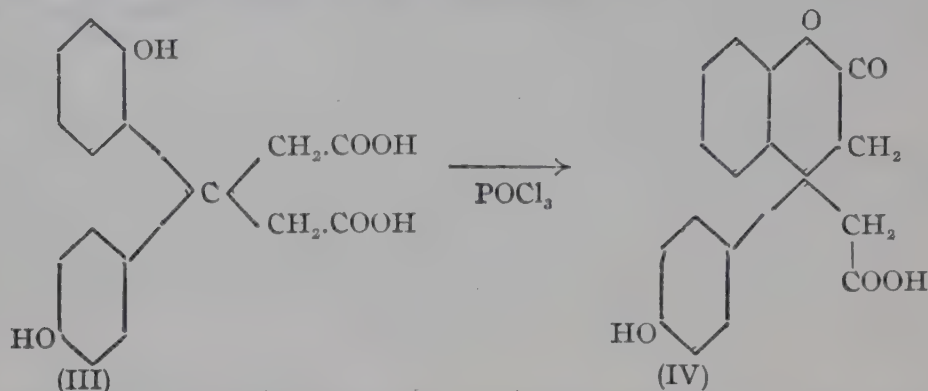
The  $\beta\beta$ -Diaryl glutaric acid (m.p. 234° decomp.) obtained by condensing phenol with acetone dicarboxylic acid is supposed to have the structural formula (I) according to Dixit and Gokhale (J. Univ. Bom., 1934, 3, 80) and the formula (II) according to Gogte (Proc. Ind. Acad. Sc., 1937, 4A, 535).





Formula (I) suggests the possibility of lactonisation to a glutaro dilactone on treatment of the acid with a suitable dehydrating agent whereas the formula (II) would facilitate the formation of a glutaric anhydride under similar conditions.

On treating the  $\beta\beta$ -dihydroxy phenyl glutaric acid (m.p.  $234^\circ$  decomp.) with phosphorus oxychloride, a monobasic acid (m.p.  $204^\circ$ ) has been obtained. The properties of this acid and the results of a number of reactions to which it has been subjected indicate that it is a monolactonic acid of the formula (IV).



The new acid (m.p.  $240^\circ$ ), on hydrolysis and methylation according to the Robertson and Canter method (J.C.S., 1931, 193, 1255), yields a  $\beta\beta$ -dimethoxy phenyl glutaric acid (m.p.  $158^\circ$ ) identical with the one obtained by simple methylation of the original glutaric acid (m.p.  $234^\circ$  decomp.). The latter compound may therefore be represented by the formula (III) above in preference to either of the formulae (I) and (II).

## 152. Hydroxy Ketones. Part IV.

G. S. SAHARIA, Delhi.

The Fries rearrangements of the esters of phenol, isomeric cresols and naphthols with *p*-nitrobenzoic acid have been studied with the intention to prepare certain possible bactericides and to study the effect of the nitro group when introduced in the acyl part of the molecule. It has been found that the electronic interference of the nitro group consequent upon its having nucleophilic positions is not prominent as long as only equimolar quantities of the ester and aluminium chloride are used, but when two moles of the latter are used, complex formation also takes place at the nitro group which on subsequent heating produce charring only.

## 153. Synthesis of 2:8-dimethyl-3-substituted-4-quinazolones.

G. S. MEWADA, S. R. PATEL, and N. M. SHAH, Ahmedabad.

The work described in this paper was undertaken to prepare 4-quinazolones with alkyl group in the benzene nucleus. Several 2:8-dimethyl-3-aryl-4-quinazolones have been synthesized by condensing 3-methyl-N-acetyl anthranilic acid with different aromatic amines ( $\text{X}-\text{C}_6\text{H}_4-\text{NH}_2$ , where  $\text{X}=\text{CH}_3$ ,  $\text{OCH}_3$ ,  $\text{Cl}$  in ortho, meta and para positions) in presence of phosphorous trichloride in dry toluene. Their hydrochlorides have also been prepared.

## 154. Coumarins derived from *p*-alkyl-phenols.

M. R. BHATT and N. M. SHAH, Ahmedabad.

This paper describes the hitherto unknown coumarins derived from *p*-ethyl, *p*-butyl and *p*-benzyl-phenol by condensation with (a) ethyl-acetoacetate and

of acetone dicarboxylic acid under the conditions of the Pechmann reaction. The coumarins obtained from (a) were found to be 4-methyl-6-alkyl coumarins and those from (b) were 6-alkyl coumarin-4-acetic acids, which on heating were easily decarboxylated giving 4-methyl-6-alkyl coumarins identical with those obtained in (a).

#### 55. Studies in Chalkones : Chalkones and related compounds derived from 5-acetamino-2-hydroxy-acetophenone.

A. A. RAVAL and N. M. SHAH, Ahmedabad.

In extension of the work that is going on in this laboratory on the synthesis and reactivity of chalkones, this paper describes the chalkones derived from 5-acetamino-2-hydroxy-acetophenone by condensation with benzaldehyde, anisaldehyde, salicylaldehyde and piperonal. 5-Acetamino-2-hydroxy-chalkones could not be de-acetylated to the corresponding amino chalkones as during the course of de-acetylation, the chalkones underwent cyclisation to the corresponding flavanones. They have been converted into flavones and flavanones which would be de-acetylated to the corresponding 6-amino derivatives.

These results show that the acetamino group does not hinder the chalkone formation.

#### 156. Studies in Friedel-Craft's Reaction : Friedel-Craft's Acetylation of Aceto-*o*-Toluidide.

(KUMARI) M. J. SACH and S. R. PATEL, Ahmedabad.

In this paper the Friedel-Crafts acetylation of aceto-*o*-toluidide with acetyl chloride had been investigated. Contrary to the observation of Kunckell et al. (Ber., 33, 2641 and 2654, 1900) the above acetylation succeeds leading to the formation of 3-acetamino-4-methyl acetophenone (I), the constitution of which has been confirmed by its unambiguous synthesis. Further (I) was hydrolysed to the corresponding 3-amino derivative.

#### 157. Synthesis of 5-methyl-acridine derivatives.

(KUMARI) M. J. SACH and S. R. PATEL, Ahmedabad.

A large number of substituted acridine derivatives have been reported with a view to test their antiseptic or antimalarial properties but very little work has been done on the synthesis of 5-methyl-acridine derivatives containing groups like  $\text{NO}_2$ ,  $\text{NH}_2$ ,  $\text{Cl}$ , or  $\text{OCH}_3$ . The present work was undertaken with a view to synthesise 5-methyl-acridine derivatives containing the above-mentioned groups from suitably substituted 2-acetyl-diphenyl amines, by cyclisation with con. sulphuric acid. Incidentally 2-acetyl-diphenyl amine derivatives required for the above synthesis are not described in literature and their synthesis has also been included in this paper.

#### 158. Nitration of 6-hydroxy-4-methyl coumarin and its methyl ether.

G. S. MEWADA and N. M. SHAH, Ahmedabad.

Whereas, the nitration of 5, 7 and 8-hydroxy coumarins has been investigated by several workers (vide 'The Chemistry of Coumarins' by Sethna and Shah, Chemical Reviews, 1945, 36, 27) hardly any work has been undertaken to study the nitration of 6-hydroxy-4-methyl coumarin except a solitary paper by Borsche (Ber., 1907, 40, 2731). This paper describes the systematic study of the nitration of 6-hydroxy-4-methyl coumarin and its methyl ether. On nitrating 6-hydroxy coumarin by concentrated  $\text{H}_2\text{SO}_4\text{-HNO}_3$  nitrating mixture (1 mol.), a mixture of two nitro



derivatives is formed, which has been separated into (i) mono-nitro (m.p. 210°) and (ii) dinitro (m.p. 220°); which have been found to be 6-hydroxy-5-nitro-4-methyl coumarin and 6-hydroxy-5:7-dinitro-4-methyl coumarin respectively. Their various functional derivatives have been prepared and their structures confirmed. Similarly, its methyl ether has been nitrated and an unseparable mixture was obtained, but the nitration with two mols. of HNO<sub>3</sub> gives the dinitro derivatives, which on demethylation gives the hydroxy dinitro compound obtained as above.

**159. Studies in Fries Migration. The Fries Isomerisation of acyl esters of ortho and para-hydroxy-acetophenones and para-hydroxy-benzophenone.**

N. M. SHAH and M. R. BHATT, Ahmedabad.

Phenolic esters with negative substituents like nitro, acetyl, benzoyl, carboxyl and carboethoxyl are reported not to undergo the Fries reaction. However, in recent years, the migrations of such phenolic esters have been successfully carried out (Brown, J. Amer. C. S., 1946, 65, 873; Shah and Shah, J. Ind. C. S., 1949, 26, 237; Amin and Shah, *ibid*, 1952, 29, 351, 915; Curr. Sc., 1952, 21, 246; Chauguley and Amin, Sci. and Cult., 1954 19, 614). Hardly any work has appeared on the Fries reaction of acyl esters of phenols containing the ketonic group except a solitary instance of 2-acetoxy-5-methyl-acetophenone. We have investigated the Fries migration of *o*- and *p*-acyloxy-acetophenones and *p*-acyloxy-benzo-phenone.

*o*- and *p*-Acetoxy-acetophenone give on migration 2-hydroxy-5-acetyl-acetophenone, the first at room temperature in presence of a solvent, and the latter at 140-150° without a solvent.

*p*-Acetoxy- and *p*-benzoxoy-benzophenone migrated giving 3-acetyl- and 3-benzoyl-4-hydroxy benzophenones. The results show that acetyl (—COCH<sub>3</sub>) and benzoyl (—COPh) group in phenolic nucleus in ortho or para position to OH group do not inhibit or retard the Fries reaction.

**160. Synthesis of some 1:4-Benzopyranols.**

(Miss) D. P. PATEL and V. M. THAKOR, Bombay.

Resorcinol has been condensed with acetylacetone in presence of 80% sulphuric acid. 7-Hydroxy-2-methyl-4-methylene-1:4-benzopyranol obtained as an orange red amorphous powder resembled in all its properties to the benzopyranol mentioned in literature. It gave an almost colourless acetyl derivative and a dark green picrate. Similar benzopyranols were also obtained from pyrogallol and phloroglucinol. These benzopyranols are amorphous powders having no sharp melting points. They become resinous and decompose.

Sharp melting crystalline products have been obtained by condensing some monohydroxy phenols with acetylacetone in presence of 80% sulphuric acid.

**161. Cannizzaro Reaction and Crossed Cannizzaro Reaction with Naphthaldehyde.**

RAM DAS TIWARI and NARENDRA PRASAD SRIVASTAVA, Allahabad.

$\alpha$ -Naphthaldehyde has been prepared by chloro-methylation of naphthalene followed by subsequent oxidation of  $\alpha$ -chloromethyl-naphthalene with hexamethylenetetramine in acetic acid solution (Org. Syn., vol. 24, 1944 p. 30 and Org. Syn., vol. 30, 1950, p. 67).

On treatment with aqueous alkali at 50-60°C, it has been found to undergo Cannizzaro reaction with the formation of 56.9% of  $\alpha$ -naphthoic acid and 95% of  $\alpha$ -naphthyl carbinol.

Naphthaldehyde has further been subjected to crossed Cannizzaro reaction. The aldehyde in methyl alcohol solution in presence of excess of formaldehyde when treated with alkali at 65-75°C has been found to yield 70%  $\alpha$ -naphthyl carbinol.

$\alpha$ -Naphthyl carbinol has been prepared by various methods (Manske and Ledingham, Can. J. Sesearch( 17 B, 14; Ziegler Ber. 54, 737; Gomberg Bachmann, J. Am. C. S., 52, 4967; Shankland Gomberg, J. Am. C. S., 52, 4973; West, J. Am. C. S., 53, 1656).

The preparation of this carbinol from  $\alpha$ -naphthaldehyde by crossed Cannizzaro reaction is therefore a distinct advancement over the methods given above both from the point of view of yield and the ease of formation.

## 62. On the Constitution of Entagenic Acid, a new triterpenoid isolated from the seeds of *Entada pursaetha* DC.

D. CHAKRAVARTI, J. K. ROY and A. K. BARUA, Calcutta.

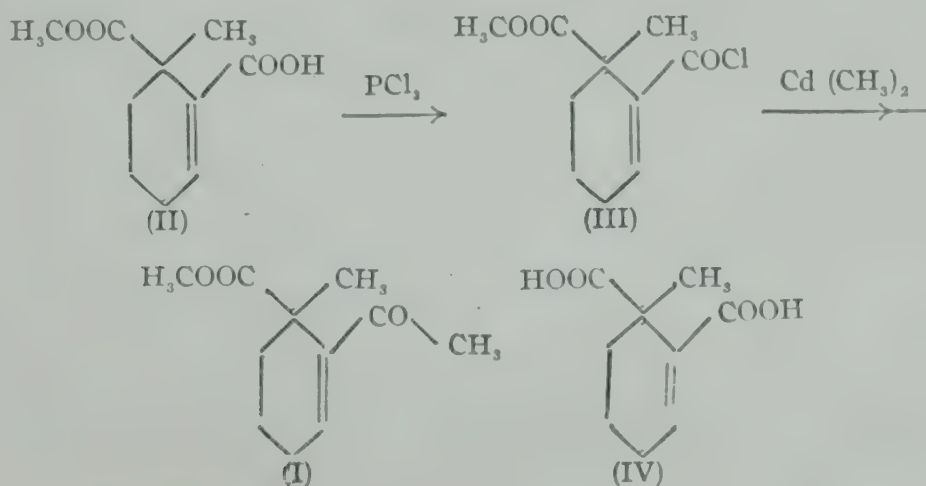
A crystalline sapogenin has been isolated from the seeds of the plant *Entada pursaetha* DC, m.p.  $293^{\circ}$ – $296^{\circ}$  (dec.). It has the molecular formula  $C_{30}H_{48}O_5$ . It gives purple to violet colouration with Liebermann Buchard reagent. It appears to be a new triterpenoid sapogenin and given the name Entagenic Acid. Infra-red spectrum shows the presence of hydroxyl groups ( $2.66$ – $2.8\ \mu$ ), a carboxyl group ( $5.9\ \mu$ ) and C-methyl groups ( $7.22\ \mu$ ). With diazo methane it gives a monomethyl ester m.p.  $243^{\circ}$ – $245^{\circ}$ . With pyridine and acetic anhydride it gives a tri-acetyl derivative m.p.  $180^{\circ}$ – $181^{\circ}$ . It gives a pale yellow colouration with tetra nitro methane. It has a hindered double bond and the position of the double bond appears to be either  $\beta\ \gamma$  or  $\gamma\ \delta$  with respect to the carboxyl as it forms a mono-bromo-lactone, m.p.  $263^{\circ}$ – $264^{\circ}$  with bromine in acetic acid. That it is a  $\gamma$ -lactone is proved by I.R. spectrum ( $5.65\ \mu$ ). With acetone and conc. hydrochloric acid, the methyl ester of entagenic acid gives an acetonyl derivative, m.p.  $200$ – $201^{\circ}$ . This proves the presence of two hydroxyl groups either in 1-2 or 1-3 position with respect to each other. Entagenic acid on oxidation with  $CrO_3$  in acetic acid gives a ketone, m.p.  $139^{\circ}$ . The ketone does not give any colouration with ferric chloride and is pale yellow in colour. This proves that it is not a  $\beta$ -diketone and most probably the two hydroxyl groups in the original compound are in 1-2 position with respect to each other.

## 63. Preparation of a suitable intermediate for the synthesis of resin acids : Synthesis of 6-methyl-6-carbmethoxy-acetyl-cyclohexene :

J. K ROY and A. K. BARUA, Calcutta.

With a view to synthesising the important resin acids, we have prepared 6-methyl-6-carbmethoxy-acetyl-cyclohexene, which may serve as a suitable intermediate for this purpose through Michael type of addition.

This compound (I) has been prepared from the half ester (II) through the following series of reactions :







### 56. Autoxidation of the Monophenol from Commercial Cashew Nut Shell Liquid and of its Methyl Ether.

LOURDU M. YEDDANAPALLI and V. V. GOPALAKRISHNA, Madras.

The autoxidation of cardanol, the monophenol from commercial cashew nut shell liquid and of its methyl ether was investigated in the presence of oxygen at atmospheric pressure and within the temperature range 110 to 150°C. The reaction was followed by measuring the oxygen absorbed with time and the corresponding changes in viscosity, iodine value, hydroxyl content and molecular weight of the products, and by estimating the hydroperoxides, acids and aldehydes in the reaction products.

Under identical conditions, the monophenol absorbs less oxygen than the methyl ether, due probably to the inhibitive action of the phenolic OH, as demonstrated also by the much less ease of formation of hydroperoxides in the case of the phenol than in that of its ether. The results are explained on the basis of hydroperoxide as the primary product of autoxidation and its subsequent part in the secondary reactions such as decomposition, and scission and polymerisation of the double bonds. The significance of these results in the phenomenon of "drying" is indicated.

### 67. Action of metal cyanides on 1-methyl-4-bromo-4-phenylpiperidine hydrobromide.

G. S. SIDHU and S. HUSAIN ZAHEER, Hyderabad.

1-Methyl-4-cyano-4-phenylpiperidine required for conversion to the analgesic pethidine was sought to be prepared by the action of potassium cyanide on 1-methyl-4-bromo-4-phenylpiperidine hydrobromide. This, however, resulted in dehydrobromination to 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine characterised as its hydrochloride. Silver and cuprous cyanides were then tried and found to react similarly.

### 68. Chemical Activities of *Pseudomonas fluorescens*.

(Miss) V. RADHA and K. RAMCHANDRAN, Hyderabad-Deccan.

*Pseudomonas fluorescens*: produces little acid in culture media containing glucose if no  $\text{CaCO}_3$  is added to such media. However, the addition of  $\text{CaCO}_3$  to the media brings about not only a quicker utilization of the glucose, but also accumulation of substantial quantities of the Calcium Salts of gluconic and of 2-ketogluconic acids. Pure calcium 2-ketogluconate in good yields has been obtained by oxidising glucose under these conditions with selected strains of this organism. The presence of traces of pyruvic acid, and small amounts of  $\alpha$ -ketoglutaric and another unidentified ketoacid in these media is established by recourse to the technique of paper chromatography of the dinitrophenyl hydrazine derivations.

It is also shown that lactate yields  $\alpha$ -ketoglutaric acid in addition to pyruvic acid, while alanine is oxidatively deaminated to give pyruvic acid, accompanied by small amounts of  $\alpha$ -ketoglutaric acid and two other unidentified keto acids. Glutamic acid yields traces only of  $\beta$ -ketoglutaric acid, while dl-mandelic acid is oxidised first to a keto compound, presumably benzoylformic acid.

### 69. Preparation of Castor Modified Alkyds by 'the Monoglyceride Method' using without catalysts and azeotropic solvent xylol. Part II.

N. BHOJRAJ NAIDU and S. A. SALETORÉ, Hyderabad-Deccan.

This paper describes the attempts made to prepare castor resins of short and medium oil groups by 'the Monoglyceride method' without catalyst at top tempera-



tures of 280°C, using phthalic anhydride and excess of glycoxol. The reactions were carried out azeotropically in a three-necked round bottom flask having provisions made for efficient stirring, withdrawals of samples, collection of water, of reaction etc., and controlling of the temperatures manually by adjusting the rate of stirring and the amount of azeotropic solvent. The resin thus obtained was clear substantially non-tacky. The resin solution of 40 per cent oil length took about 30 minutes to set-to-touch time and less than 24 hours to hard dry, as against 2½ hours and more than 24 hours respectively for a 50 per cent castor resin, showing thereby that the drying rate is inversely proportional to the oil length of the resin. It was found soluble in benzene, toluene, hexanol and butyl acetate and had a viscosity at 30°C. 98.5 poises (62.4% solids in xylol.) and acid value 6.4, saponification equivalent 165.2 and iodine value 45.0. Its suitability for white air drying or for baking enamels is suggested. Stoving at 120°C for an hour gave hard and glossy films. The use of driers was dispensed off in the stoved films.

#### **170. Studies on storage of Indian Cottonseed and oil : Part I.**

V. R. HARWALKAR and S. A. SALETORÉ, Hyderabad-Deccan. .

With a view to gather data on the behaviour of Indian cottonseed on storage under different conditions of artificial humidity and temperature, a local variety of cottonseed (American Parbhani I) was stored in humidity cabinet at 41°C. and 85 percent relative humidity and at 33°C. and 70 percent humidity. At 41°C. and 85 percent humidity the seeds had increased in free fatty acids from 1.15 to 29.80 percent at the end of 3 months storage, although peroxide value had not much altered. The control under atmospheric conditions had increased only to 2.04 percent. The equilibrium moisture content was about 15 percent. The viability of the seeds was 100 percent at the beginning but was nil at the end of 3 months storage. The meats became dark coloured and extremely mouldy, though the colour of the seeds was not appreciably changed.

At 33°C. and 70 percent humidity the free fatty acids had increased only from 2.04 percent to the extent of 3.02 after storage of 8 weeks.

#### **171. Preparation of Castor Modified Alkyds by the "Monoglyceride method" using the catalysts and azeotropic solvent Xylol. Part III.**

N. BHOJRAJ NAIDU and S. A. SALETORÉ, Hyderabad-Deccan.

This paper discusses with tables of experimental data the preparation of castor resin by the two stage alcoholysis process. Castor oil and glycerol were heated to 225°C. in about 45 minutes and then added phthalic anhydride and the alcoholysis catalyst litharge at 180°C. and finally the reaction mixture was raised to 280°C. where it was held there for few minutes. Small amounts of calcium hydroxide, lead oxide and quinoline were added on the basis of glycerine in separate runs and the resins compared. Either triphenyle phosphite or phosphoric acid was added to remove the haze formed due to the calcium phthalate formed in the resin. Drying times of 50 percent castor modified resin of 2.0 poses viscosity at 30°C. containing 0.05 percent cobalt on the weight alkyd, were determined and found to be tack free in about 3 hours, while that of 40 percent resin was found to be tack free in about 2½ hours, showing thereby that drying rate is a function of oil base ratio. A 66.5 percent resin solution in a mixture of butanol and butyl acetate had a viscosity at 30°C. 2.25 poses with an acid value 0.5. The resin prepared with quinoline had high colour and its use in white paints is not recommended, while those with calcium hydroxide may be used with advantage in white paints.

## 72. Phosphorus oxychloride as condensing agent for the Pechmann Reaction : Phenolic esters of coumarin-4-acetic acids.

V. M. DIXIT and B. R. RAVIKIRAN, Dharwar.

m-Cresol and p-cresol were condensed with acetone dicarboxylic acid using phosphorus oxychloride as the condensing agent. In addition to the respective coumarin-4-acetic acids a new non-acidic product was obtained in each case. These products are found to be different from the corresponding glutaro dilactones.

The product from m-cresol melts at 160° and that from p-cresol at 190°. Analysis and an approximate determination of molecular weight agree with the formula  $C_{12}H_{10}O_4$  for both compounds. Chemically the compounds show the following characteristics :

- (i) They give the respective coumarin-4-acetic acids and cresols by alkaline as well as acidic hydrolysis.
- (ii) On reduction with sodium amalgam, both give the respective 3:4-dihydro coumarin-4-acetic acids.
- (iii) Bromination gives a mono-bromo derivative. The bromo derivatives on hydrolysis give the known 7-methyl and 6-methyl coumarin-4-bromo acetic acids.
- (iv) When subjected to simultaneous hydrolysis and methylation both compounds yield the corresponding  $\beta$ -2-methoxy phenyl glutaconic acids and the cresyl methyl ethers.

Both compounds enter into a Knoevenagel condensation with salicylic aldehyde in the presence of pyridine and yield the respective dicoumaryls which are known. (Dey and Row, J. Ind Chem. Soc., 1924, I, 107.)

In view of the above experimental evidence the new compounds are considered to be the cresolic esters of the respective coumarin-4-acetic acids.

Their constitution has been further established by their direct synthesis by esterifying the respective coumarin-4-acetic acids with the corresponding cresol under the influence of dry hydrochloric acid gas in ethyl acetate solution. Like other phenolic esters, these compounds are also found to undergo Fries Rearrangement when heated with anhydrous aluminium chloride. The constitution of the resulting ketonic compounds has been established.

## 173. Addition of Iodine 3,5-dinitrobenzoate to Terpenes.

S. HUSAIN ZAHEER, BHARAT BHUSHAN and G. S. SIDHU, Hyderabad-Deccan.

Halperin, Donahoe, Kleinberg and Vandenberg (J. Org. Chem., 1952, **17**, 623) reported that crystalline derivatives of simple olefins could be obtained by addition of iodine 3,5-dinitrobenzoate at the double bond. It was considered of interest to extend this reaction to terpenes in an attempt to obtain easily identifiable crystalline compounds. Of the terpenes and the cyclo-olefins tried, only  $\alpha$ -pinene and cyclo-hexene gave solid derivatives.  $\alpha$ -pinene gave an addition compound having a m.p. 114-116°C, while the derivative from cyclo-hexene had a m.p. 129-130°C. The former showed an absence of halogen, indicating the removal of tertiary halide during the isolation, possibly while washing with sodium carbonate solution. The addition products obtained from camphene,  $\Delta^3$  and  $\Delta^4$ -carenes,  $\beta$ -pinene, longifolene, dipentene and limonene were liquids.

## 174. Condensation of s-dichloroacetone with phenol and its ethers.

S. HUSAIN ZAHEER and BALDEV SINGH, Hyderabad-Deccan.

Condensation of s-dichloroacetone with phenol and its ethers in presence of conc. sulphuric acid and anhydrous aluminium chloride respectively as condensing agents



was undertaken with a view to obtaining compounds of potential insecticidal value. With sulphuric acid at 0°C, two molecules of phenol (or its ethers) reacted at the carboxyl, giving crystalline products. The condensation product from phenol crystallised from benzene giving faintly pink coloured, turning deep violet on standing, needle shaped crystals of 1,3-dichloro-2,2 bis-(p-hydroxyphenyl) propane darkening at 120° without a distinct m.p. diacetate m. 149-150°, di-tosylate m. 117-118°. With anisole, needle shaped colourless crystals m.p. 58-59° of 1,3-dichloro-2,2-bis-(p-methoxyphenyl) propane and with phenetole, needle shaped colourless crystal m.p. 70-71° of 1,3-dichloro-2,2-bis-(p-ethoxyphenyl) propane were obtained.

With anhydrous aluminium chloride at 0°C, phenol and its ethers condensed giving semi-solid resinous products which could not be worked up to give any identifiable products.

All the above-mentioned crystalline and semi-solid resinous products were tested against *Bruchus Chinensis*. h., but were found to have no marked insecticidal action.

### 175. An investigation on the Glycosides of *Digitalis lanata* Ehrh. grown in Kashmir. Part I.

S. K. GANGULY and B. K. MOZA, Calcutta.

A preliminary investigation on the glycosides of *Digitalis lanata* procured from Kashmir about one year back, has been made. It appeared from our observations that the particular sample did not contain any lanatosides. Attempts were then made to isolate the secondary glycosides from these dried leaves by treating them with white kerosine oil and ether and then subjecting them to mild alkali treatment with magnesium oxide and subsequently extracting the glycosides with 80 per cent ethanol. A mixture of secondary glycosides could be isolated from purified extract by fractional concentration and precipitation with sodium chloride. The mixture on further fractional crystallisation from dilute methyl alcohol gave a fraction melting at 234°—236° with decomp. and giving tests for sugar and aglucone of the secondary glycosides of digoxin type.

### 176. Synthesis of 8-aminoquinolines : Part VI.

A. RAYCHAUDHURI and U. P. BASU, Calcutta.

In an approach to prepare 8-aminoquinolines having an aminocresol moiety, 8-(3'-diethylamino-methyl-4'-hydroxyphenyl)-amino quinoline (I) has been synthesised. This compound, though found ineffective at lower dosage, shows some antimalarial activity at a higher dose level, with some toxic symptoms. In connection with the synthesis of an analogue of (I) with chlorine substitution at the 7-position, 7-chloro-8-hydroxy quinoline (II), which was prepared directly from 2-nitro-6-chlorophenol by a modified Skraup reaction, has been condensed with p-methoxy-benziminocloride and the rearrangement of the resulting product is under study. p-hydroxy- $\gamma$ -bromopropyl aniline hydrobromide (III) and p-hydroxy- $\beta$ -bromo-ethyl aniline hydrobromide (IV) have been prepared and (III) has been condensed with 6-methoxy-8-aminoquinoline, and the hydrochloride of the resulting base prepared.

### 177. Search for New Antispasmodics : Part VII.

T. N. GHOSH and SAKTIPADA DUTTA, Calcutta.

With the object of synthesising *iso*-quinoline derivatives containing tertiary amino groups as possible antispasmodics, *o*-methoxy-allylbenzene (I) has been brominated to yield  $\alpha$ : $\beta$ -dibromo- $\gamma$ -(*o*-methoxyphenyl)-propane (II). (II), when condensed with diethylamine, though under very mild conditions, has furnished  $\alpha$ -diethylamino- $\gamma$ -(*o*-methoxyphenyl)-propylene (III). The formation of the unsaturated compound (III) through the facile elimination of HBr has precluded further investigation along this route. The second approach involves condensation of ethyl cyanacetate with

acetamido- $\beta$ -phenyl) ethyl methyl ketone in presence of ammonium acetate to furnish 1-carboethoxy-1-cyano-2-methyl-3-acetamido-4-phenyl-1-butylene (IV) which on catalytic hydrogenation has yielded the corresponding butane (V). Bischler-pieralski cyclisation of (V) under various conditions is under study. Similarly, the condensation of  $\alpha$ -acetamidobenzophenone with ethyl cyanacetate under similar conditions has resulted in the formation of ethyl  $\alpha$ -cyano- $\beta$ -phenyl- $\gamma$ -acetamido-crotonate (I), which is undergoing similar treatment.

#### 8. Swietenolide, the bitter Principle of *Swietenia Macrophylla*.

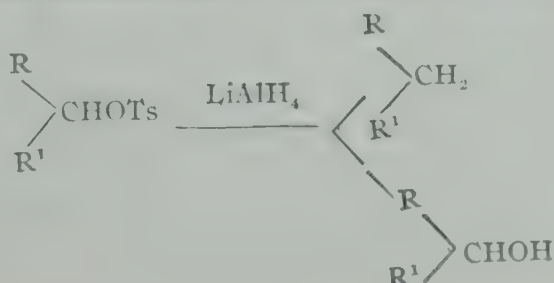
ASIMA CHATTERJEE and TARAKESHWAR CHAKRAVARTY, Calcutta.

The chloroform extract of the powdered and defatted seeds of *Swietenia macrophylla* (Fam. *melicaceae*) deposited a gummy solid from which the nonbitter principle, Swietenine (Chakravarty and Chatterjee, *J. Indian Chem. Soc.*, in press) separated out as an insoluble mass on treatment with alcohol. The alcoholic solution which dissolved mainly swietenolide, the bitter constituent of the seeds was freed from the solvent and the residue upon crystallisation from ethyl acetate yielded a mixture of swietenolide and a little Swietenine. Pure and homogeneous swietenolide has been prepared from this mixture by its chromatography over alumina using chloroform as the solvent and the eluent. Swietenine first came out of the column but not swietenolide which could only be eluted out by acetone. Homogeneous swietenolide,  $C_{15}H_{24}O_6$ , m.p.  $197-98^\circ$ ,  $[\alpha]_D^{32} = -130.9^\circ$  is fairly soluble in alcohol, chloroform and ethyl acetate, sparingly in benzene, ether and petroleum ether. The U.V. spectrum of swietenolide (studied in ethanol) shows an intense absorption near the region  $220-225 m\mu$  indicative of the presence of a hexenolactone in the compound and also an absorption maxima at  $281 m\mu$  characteristic of an isolated carbonyl group. Its I.R. spectrum (in Nujol mull) exhibits strong bands at  $2.86$ ,  $5.73$ ,  $5.9$ ,  $6.1$  and  $7.25 \mu$  respectively indicating the presence of a hydroxyl group, an  $\alpha$   $\beta$ -unsaturated  $\delta$ -lactone, a ketocarbonyl group, a double bond (conjugated with the carbonyl of the lactone) and  $-C-CH_3$  group. The presence of all these functional groups has been confirmed from chemical evidences. Swietenolide contains a methoxyl group and responds certain colour reactions characteristic to those of sterols viz., Liebermann—Burchardt, Salkowski and Rosenheim reactions. It reduces Tollen's reagent and develops a pink colour with 5% alcoholic caustic potash solution showing that the hydroxyl group in swietenolide is in allyl position to the double bond associated with the lactone group. With decinormal alcoholic sodium hydroxide the bitter substance forms an acid, m.p.  $180-181^\circ$  which undergoes easy reconversion into the original substance. Although the double bond in swietenolide is reluctant to catalytic hydrogenation, it adds up a molecule of bromine (estimated by the method of Winkler).

#### 79. Reduction of tosyl esters with lithium aluminium hydride.

P. KARRER and A. K. MITRA.

It has been shown by Karrer and Schmid (*Helv. Chim. Acta*, 1949, 32, 1371) that tosyl esters give two kinds of products on reduction with lithium aluminium hydride. This process of reduction can be represented schematically as follows:—



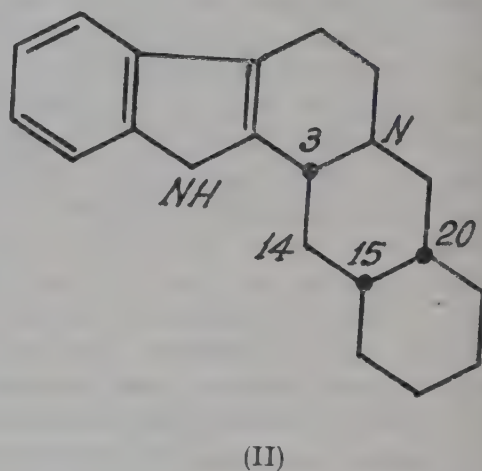
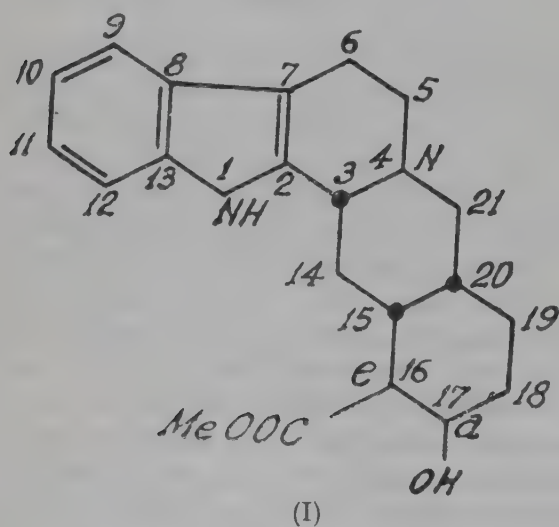


Our attempt was to prepare some of the desoxy compounds with the help of this elegant method of synthesis. The tosyl ester of 1, 2-O-isopropylidene-1-arbinose and hederagenin-2, 23, 28-triol were prepared. On reduction with lithium aluminium hydride 1,2-O-isopropylidene-3, 5-O-di-tosyl-1-arabinose gave monoacetone arabome-thylose in good yield but the tritosyl ester of hederagenin was simply detosylated.

**180. Studies on the Steric hindrance to N-acylation of Indole—NH group in Rauwolscline, the Alkaloid of *Rauwolfia canescens*, Linn.**

A. CHATTERJEE and S. PAKRASHI, Calcutta.

It has been reported earlier by the present authors that rauwolscline (I) the alkaloid of *R. canescens*, Linn (*Naturwiss*, 1954, 41, 215) has all syn configuration at C<sub>3</sub>, C<sub>15</sub> and C<sub>20</sub>, the orientation of the carbomethoxyl and the hydroxyl groups being equatorial and axial respectively. Now, indole-NH group in rauwolscline can not be acetylated. From an examination of molecular models made to scale (manufactured by the Catalin Ltd., Waltham Abbey, Essex, U.K.) it has been possible to find out that N-acetylation of indol-NH group in rauwolscline would fail for equatorial orientation of the carbomethoxyl group which is really the case. It has been further observed that acylation of -NH group is also hindered by the axial hydrogen at C<sub>14</sub>.



It therefore appears important to determine whether the equatorial—COOMe group or the axial hydrogen at C<sub>14</sub> has the major contribution in playing the role of steric hindrance towards N-acyl formation in rauwolscline system.

It is a fact that N-acylation fails in rauwolscline. Now the equatorial carbomethoxyl group is eliminated from rauwolscline by Oppenauer-oxidation and subsequently by Huang Minlon variant of the Oppenauer reaction product when—OH group is simultaneously removed. The product thus obtained is rauwolsane (II), C<sub>19</sub>H<sub>21</sub>N<sub>2</sub>, m.p. 156°. It is found to be extremely reluctant to acetylation. On acylation with (Ac)<sub>2</sub>O and pyridine or with fused sodium acetate at the reflux temperature for 20 hours homogeneous rauwolsane yields a mixture of several substances which on chromatography over Al<sub>2</sub>O<sub>3</sub> (Merck) using a mixture of benzene and petroleum ether (8:2) as an eluent afforded 80% of unreacted rauwolsane m.p. 156°, a compound (in 15% yield) m.p. 207-9°—free from acetyl group and 2% of a noncrystallisable mass responding positive test for acetyl group. From these experiments it can now be definitely assessed that the axial hydrogen at C<sub>14</sub> has the major contribution towards the steric hindrance of N-acylation of indole—NH group in rauwolscline otherwise 50% or more acetyl derivative should have been formed from rauwolsane on acetylation.

## Constitution of Ajmaline, the Alkaloid of *Rauwolfia Serpentina* Benth.

A. CHATTERJEE and S. BOSE, Calcutta.

Previous work by the present authors on the Chemistry of Ajmaline  $\text{C}_{20}\text{H}_{28}\text{N}_2\text{O}_2$ , m.p.  $158-160^\circ$ , the major alkaloid of *R. serpentina* Benth (Fam. *Erythraecynaceae*) has demonstrated (Fortschritte der Chemie Organischer Naturstoffe, 3, 10, 390) that it has a  $\beta$ -carboline structure, the site of  $-\text{C}-\text{CH}_3$ ,  $-\text{COH}$ —and  $-\text{O}-\text{C}$ —groups in the base being still undetermined. Further elucidation of the structure of ajmaline has been possible from the studies of its behaviour towards lithium borohydride, sodium and liquid ammonia, lithium aluminium hydride, also in the studies of selenium dehydrogenation experiments of sodium borohydride, sodium-liquid ammonia reduction products, their  $\text{pK}_\text{b}$  values and  $\text{pK}_\text{b}$  value of the original base.

With  $\text{LiAlH}_4$  ajmaline refuses to undergo any reduction even at high temperatures. It can be reduced, however, quite readily with sodium borohydride and sodium-liquid ammonia when no deoxydihydro base is produced but simply dihydroajmaline,  $\text{C}_{20}\text{H}_{28}\text{N}_2\text{O}_2$ , m.p.  $190-192^\circ$ , dec. Sodium borohydride and sodium-liquid ammonia reduction products are exactly the same, their I.R. spectra being also identical.  $\text{pK}$  values of ajmaline and dihydroajmaline are 6.12 and 6.06 respectively indicating that they are very weak bases. On dehydrogenation with selenium at  $300^\circ$ , dihydroajmaline furnishes only Ind-N-methyl harman. The physical and chemical evidences accumulated so far suggest that ajmaline is a  $\beta$ -carboline alkaloid having allylamine structure and further they exclude the possibility of the carbinol amine structure of the base, as  $\text{pK}_\text{b}$  for carbinol amine bases ranges from 11-13, and they undergo facile reduction with  $\text{NaBH}_4$  and  $\text{LiAlH}_4$  producing deoxydihydro bases which have not been observed in ajmaline.

## 2. The Shape of the Tropine Molecule.

AJAY K. BOSE, Kharagpur.

The infrared spectra of several tropine derivatives have been studied. From the single or multiple nature of the C—O stretching peak in the 8 region, it has been concluded that the acetoxy group is equatorial in pseudo-tropine derivatives and is axial in tropine derivatives. From the position of the strongest band in the  $1000\text{ cm}^{-1}$  region (C—O stretching of C—OH) of some tropine derivatives, it can be deduced that the hydroxy group should be equatorial in pseudo-tropine if it is axial in tropine.

If intramolecular hydrogen bonding occurs to an appreciable extent in pseudo-tropine, the piperidine ring should assume the boat form and the hydroxy group should be axial. But, we have found that the OH absorption in the  $1000\text{ cm}^{-1}$  region in pseudo-tropine is at a lower wavelength than in tropine. This indicates that the contribution of the boat form is not very large. Further, one would expect intramolecular hydrogen bonding to be much less important in N-benzoyltropine than in nor-pseudo-tropine or pseudo-tropine and consequently the absorption band in the  $1000\text{ cm}^{-1}$  region would be expected at a shorter wavelength. The observation that N-benzoyl-nor-pseudo-tropine, nor-pseudotropine and pseudo-tropine absorb at exactly the same position also points to the absence of any extensive intramolecular hydrogen bonding in pseudo-tropine.

The OH group in tropine behaves like an axial group and therefore tropine cannot have the piperidine ring in the boat form. We therefore conclude that the chair form of the piperidine ring is by far preferred to the boat form both in tropine and pseudo-tropine.



**183. Chemical study of the Saponins from *Entada Scandens*, Benth (Gila).**

N. L. DUTTA, Poona.

Most of the earlier investigations of saponin-glycosides have been based on the study of the nature of the aglycone but the work on the sugar constituents is limited. Investigation on a systematic study of the composition of saponins from Indian raw materials has been undertaken in this Laboratory. The present paper deals with the isolation of the glycosides in pure form from *Entada Scandens* Benth (Gila) and characterisation of the sugar constituents by the method of paper chromatography according to Partridge (Biochem. J., 1948, 42, 238). Two saponins have been isolated from the seed-kernel of *E. scandens* in a total yield of 7.5% on the weight of the defatted kernel.

Saponin A is an almost colourless, slightly hygroscopic powder, which softens and gradually decomposes above 116°C. It has an ash content of 0.18%  $[\alpha]_D = +28^\circ$  (C, 2.5 water); found: C, 45.05, H, 6.5;  $(C_6H_{10}O_5)_n$  requires C, 44.44; H, 6.17 per cent.

Saponin B is a pale yellow, slightly hygroscopic powder which softens and gradually decomposes above 150°C. It has an ash content, nil,  $[\alpha]_D = +8^\circ$  (C, 2.5 water); Found: C, 48.1, H, 6.7;  $(C_7H_{11}O_3)_n$  requires C, 43.0; H, 6.28 per cent.

Paper chromatography of the saponin-hydrolysates shows the presence of glucose, galactose, xylose and arabinose, almost in equal proportions in the case of saponin A whereas the saponin B contained glucose, xylose and arabinose almost in equal proportions and a trace of galactose. The absence of galacturonic acid (Schneider and Bock, Ber., 1937, 70B, 1617) in the chromatogram shows the saponins to be free from pectin.

**184. Anthoxanthins : Part III. Synthesis of Flavan-3 : 4-diols.**

C. G. JOSHI and A. B. KULKARNI, Poona.

In continuation of our work on the reduction of anthoxanthins with lithium aluminium hydride and synthesis of catechin type of compounds, it has now been observed that 6-methyl-3 : 4'-dimethoxy-flavone is reduced to the corresponding flavene m.p. 108°C. Pentamethyl ether of quercetin, however, could not be reduced to the corresponding flavene. Since the route quercetin  $\rightarrow$  flavene  $\rightarrow$  catechin appeared to be unpromising, attempts were made to proceed through flavanones to the corresponding flavan derivatives. 6-Methyl-4'-methoxy flavanone on reduction with this reagent gave 6-methyl-4'-methoxyflavan-4-ol m.p. 138°C. To bring about the reduction of the -CO group in flavanone to the -CH<sub>2</sub> group and not to a -CHOH group as observed above, it was thought worthwhile to make use of a mixed reagent lithium aluminium hydride-cobaltous chloride, which as observed by us reduces the -CO group in xanthenes to the -CH<sub>2</sub> group. However on reduction with this mixed reagent, 3-hydroxy-4'-methoxy-6-methyl-flavanone gave two flavan 3 : 4-diols (i) m.p. 193°C, diacetate, m.p. 98°C, (ii) m.p. 169°C, diacetate, m.p. 123°C. The analytical results show that they are presumably cis-trans isomers in position '4'. No serious attempt seems to have been made in the past for the synthesis of flavan-3 : 4-diol probably because no pure flavan-3 : 4-diol derivative was isolated from natural resources. From the point of view of synthesis of melacacidin, its isomers and other leucoanthocyanidins which are flavan-3 : 4-diol derivatives, the simple and elegant method described above appears to be promising.

**185. The Delphinine alkaloid.**

BHOLA NATH, Poona.

Modifications have been introduced in the method of isolating alkaloids from *D. staphisagria* L. seeds (Ranunculaceae family) commonly known as 'stavesacre', and in the hydrolysis of delphinine to delphonine.

Delphonine has been completely demethylated to  $C_{20}H_{31}O_7N$ . This on zinc dust dehydrogenation gave two fractions :

(a) Basic—methylamine, a pyridine homologue and a crystalline base.

(b) Neutral—a hydrocarbon,  $C_{17}H_{26}$  and an oxygenated compound,  $C_{18}H_{22}O_3$ . An ultra-violet spectrum of the hydrocarbon indicates a benzenoid structure. Moreover the hydrocarbon resists further dehydrogenation with selenium and palladium black. This extraordinary resistance may imply two things.

(1) The nucleus is of a perhydro-phenanthrene type or of any other perhydro-fused ring system and contains such centres that prevent complete dehydrogenation.

(2) It may be of a bicyclopentenobenzene type and therefore may belong to a different category from the diterpenes with which the accompanying non-toxic alkaloids have been provisionally classified.

Dehydration of the demethylated delphonine gave a ketone,  $C_{20}H_{29}O_6N$ .

#### 186. Chemical investigation of "khair gum". (*Acacia catechu*; N. O. Leguminosae.) Part I :—Composition of the khair gum.

R. K. HULYALKAR, T. R. INGLE and B. V. BHIDE, Poona.

The purified khair gum (*Acacia catechu*; ash 0.98%) was non-reducing and possessed an equivalent weight 1025 circa. The gum was hydrolysed with 10% sulphuric acid up to the stage of aldo-bionic acid. Further hydrolysis was not possible due to the resistive nature of the aldo-bionic acid. The chromatographic examination of the hydrolysate revealed the presence of galactose, arabinose and rhamnose. These sugars were isolated in the crystalline form and were characterised by preparing their specific derivatives. The presence of glucuronic acid in the aldo-bionic acid was confirmed by obtaining the characteristic crystals of potassium acid saccharate by the oxidation of aldo-bionic acid by the method of Heidelberger and Goebel (J. Biol. Chem. 74, 613, 1927). The sugar part of the aldo-bionic acid was proved to be galactose by obtaining mucic acid from it in the usual manner.

The routine analysis of the gum indicated the following composition :

(i) Galactose	...	...	...	...	49.92%
(ii) Arabinose	...	...	...	...	17.50%
(iii) Uronic acid anhydride	...	...	...	...	17.60%
(iv) Rhamnose	...	...	...	...	14.00%

#### 187. Chemical investigation of the gum khair. (*Acacia catechu*; N. O. Leguminosae.) Part II :—Structure of the aldo-bionic acid.

R. K. HULYALKAR, T. R. INGLE and B. V. BHIDE, Poona.

Hydrolysis of the khair gum with 5% sulphuric acid yielded an aldo-bionic acid. To study the nature of linkage between the two units of the aldo-bionic acid, it was methylated and the fully methylated product was subjected to hydrolysis with 7% hydrochloric acid. Two sugars were thus separated which were isolated and identified by preparing their characteristic derivatives.

(i) Sugar :—2 : 3 : 4, trimethyl galactose.

(ia) Derivative :—Anilide of 2 : 3 : 4 : tri methyl galactose (m.p. and mixed m.p. 165°).

(ii) Sugar :—2 : 3 : 4 : tri methyl glucuronic acid.

(iia) Derivative :—2 : 3 : 4 : tri methyl glucosaccharo 1 : 5 lactone 6, methyl ester. M.p. and mixed m.p. 108°C.

The structure of the aldo-bionic acid was found to be 1 : 6 glucuronosido galactose.



188. Chemical investigation of Modal Gum. (*Lannea grandis* ; N. O. Anacardiaceae.) Part I :—Composition of Modal gum.

V. M. PARIKH, T. R. INGLE, and B. V. BHIDE, Poona.

The modal gum (*Lannea grandis*), a minor forest produce in the Bombay state, is found to be a neutral polyuronide (Ash 5.158%). The qualitative analysis of the ash indicated the presence of Fe, Ca, Mg and CO<sub>3</sub>. The purified gum (Ash 0.6%) was non-reducing and had an equivalent weight 1245 circa. On hydrolysis with 10% sulphuric acid it yielded galactose, arabinose and an aldo-bionic acid. Galactose and arabinose were obtained in crystalline forms (Galactose) m.p. 165°;  $\alpha_D^{27} = +80$ , Arabinose m.p. 158°; and  $\alpha_D^{27} = +101$ .) and were identified by preparing their crystalline derivatives. The barium salt of the aldo-bionic acid (Ba=17.55% OMe=7.25%  $\alpha_D^{27} = +10$ ) was found to be resistive to hydrolysis with 10% sulphuric acid and the chromatographic examination of the hydrolysate after 20 hours indicated the presence of galactose only. On methanolysis of this aldo-bionic acid, the viscous syrup obtained was taken up in acetone and the methyl galactoside was precipitated by ether. The ether soluble fraction was distilled under reduced pressure (b.p. 178-185°/3 mm.) The viscous liquid thus obtained was proved to be methyl ester of 4-methyl methyl-D-glucuronoside by preparing its amide (m.p. 232°C.  $\alpha_D^{27} = +152$ ). This indicated that the uronic acid present in the gum was 4-methyl-D-glucuronic acid.

The routine analysis of the gum indicated the following composition.

- (i) Galactose—69.91%.
- (ii) Arabinose—12.31%.
- (iii) 4-Methyl uronic acid anhydride—16.32%.

189. Chemical investigation of Modal Gum. (*Lannea grandis* ; N. O. Anacardiaceae.) Part II :—Structure of the aldo-bionic acid.

V. M. PARIKH, T. R. INGLE, and B. V. BHIDE, Poona.

The aldo-bionic acid obtained by the hydrolysis of the gum with 3% sulphuric acid, was fully methylated and hydrolysed by 7% hydrochloric acid when two sugars were obtained. One of them was indentified as 2 : 3 : 4 tri-methyl galactose by preparing its anilide. M.p. 165°C. A mixed melting point with an authentic sample of 2 : 3 : 4 tri-methyl galactose anilide remained unchanged. The other sugar, which was isolated as its barium salt (Ba=22.38% ; OMe=30.28%) was identified to be 2 : 3 : 4 tri-methyl glucuronic acid by preparing methyl ester of its lactone viz. 2 : 3 : 4 tri-methyl glucosaccharo 1 : 5 lactone 6 methyl ester. (M.p. and mixed m.p. 108°C.).

Thus the aldo-bionic acid present in the modal gum was proved to be 1 : 6 (4-methyl glucuronosido)-galactose.

190. Chemical investigation of "Bael mucilage". (*Aegle marmelos* ; N. O. Rutaceae.) Part I :—Composition of Bael mucilage.

V. M. PARIKH, T. R. INGLE, and B. V. BHIDE, Poona.

*Aegle marmelos*, called as bael tree, is widely distributed throughout India and has an immense medical importance. The mucilage which is abundant in the fruits is prescribed for dysentery and diarrhoea by local medicinal practitioners and is regarded as astringent, digestive and stomachic. The mucilage obtained in the form of dry powder on treatment with alcohol is found to be a neutral polysaccharide. On hydrolysis with 10% sulphuric acid the hydrolysate was found to contain

galactose, arabinose and rhamnose. Galactose and arabinose were isolated and were confirmed by preparing their specific derivatives.

The routine analysis of the mucilage indicated the following composition.

- (i) Galactose—85.27%.
- (ii) Arabinose—8.44%.
- (iii) Rhamnose—2.16%.

#### 191. Sitosterols from *Mimosa Pudica* Linn.

BIDYUT KAMAL BHATTACHARYYA and JADUGOPAL DUTTA,  
Jadavpur, Calcutta.

Unsaponified matter of seeds of *Mimosa pudica* linn has been examined by chromatographic method. The major constituent appears to be  $\beta$ -Sitosterol containing some  $\gamma$ -Sitosterol.

#### 192. Experiments towards the synthesis of Santonin or its stereoisomerides.

P. C. DUTTA, Calcutta.

1 : 10-Dimethyldecalin- $\Delta$ -1 : 9, 7 : 8-dien-2-one (J. Chem. Soc., 1437, 1952) has been condensed with ethyl methylmalonate to give the desired diester (b.p. 175-90°/0.4 mm. Red Dinitrophenylhydrazone 101-03°C) in which the methylmalonic ester residue has attached itself at C<sub>7</sub>— in the equatorial position. Alkaline hydrolysis gave the dibasic acid (m.p. 190-92°). This has been described by McQuillin (Chem. & Industry, 311, 1954) having the melting point 178°C. On decarboxylation of the dibasic acid, two monocarboxylic acids have been separated one of which melts at 130-32°, which is most probably the purer form of the acid melting at 125°C described by Abe *et al.* (J. Am. Chem. Soc., 2567, 1953) and another isomeric acid has also been isolated from the mother-liquor melting at 112-14°C the stereochemical homogeneity of which cannot be definitely stated at this stage. It might be the acid described by McQuillin melting at 118° obtained by thermal decarboxylation of the acid melting at 178°. The conversion of these isomeric acids into dihydrosantonin or its isomer according to the method, successfully worked out and reported earlier (Science & Culture, 19, 164, 1953) is being actively pursued.

#### 193. Saponins from Indian *Dioscorea* Plants.

A. K. BARUA, (Mrs.) D. CHAKRAVARTI and R. N. CHAKRAVARTI,  
Calcutta.

Since the discovery of the antirheumatic arthritic hormone, cortisone, by Kendall *et al.*, Reichstein, and Wintersteiner and Pfiffner in 1936, much attention has been focussed on the steroidal sapogenins of plants. A comprehensive investigation was undertaken in this direction by Marker and his collaborators on the sapogenins of various wild plants particularly plants of N. O. Liliaceae and Dioscoreaceae. We have been carrying out an investigation on the yams of Indian *Dioscorea* Plants with a view to find out a suitable Indian source of diosgenin or any other sapogenin which may be useful for the preparation of cortisone and some of the other cortical hormones and the sex hormones. It has been possible to collect the yams of nineteen different species of plants of this family. Out of these diosgenin has been isolated from *D. esculenta* (yield, 0.17%), *D. prazeri* (yield, 2.1%), and *D. deltoidea* (yield, 3.35%).

It has also been possible to isolate the saponins of *D. prazeri* and *D. deltoidea* in the crystalline state. The saponin isolated from *D. prazeri*, crystallises from



70% alcohol and melts at 282° (dec.). That isolated from *D. deltoidea* also crystallises from 70% alcohol and melts at 298° (dec.).

#### 194. Chemical Examination of the Colouring matters from the seeds of *Cassia-tora*.

RAM DAS TEWARI and PURNA CHANDRA GUPTA, Allahabad.

The colouring matter isolated from the seeds of *Cassia tora* has been resolved into three products by fractional crystallization from chloroform and acetone. One of the colouring matters shining orange named A, M.P. 236-38°C and molecular formula  $C_{15}H_{14}O_5$  was found to contain two phenolic hydroxy groups and one methoxy group and on distillation with zinc-dust gave anthracene. It was found to be dihydroxy, methoxy anthraquinone.

The second colouring matter B, dark in colour, M.P. 196-98°C and molecular formula  $C_{16}H_{12}O_5$  was found to contain two phenolic and one methoxy groups and on zinc-dust distillation gave 2-methyl anthracene. Hence it was found a dihydroxy, methoxy, 2-methyl anthraquinone.

The third one C which is yellow in colour has M.P. 229-30°C and molecular formula  $C_{15}H_{10}O_4$ . It was found to have two phenolic hydroxy groups and on zinc-dust distillation 2-methyl anthracene and some 2-methyl anthraquinone were obtained. Hence it may be dihydroxy methyl anthraquinone.

The relative positions of the phenolic and methoxy groups in the three compounds are being determined.

### BIOCHEMISTRY

#### 196. Amino Acid composition of different tissues of rat under chlorotone.

N. C. GANGULI and S. C. ROY, Calcutta.

The rat can synthesise ascorbic acid in course of its normal metabolism and this can be greatly accelerated under chlorotone. The amino acid composition of different tissues such as brain, liver and kidney of rat under chlorotone has been studied with the help of two-dimensional and also circular paper chromatographic techniques. The sulphur containing acids such as methionine and cystine increase more as compared to other amino acids.

#### 197. A synthetic homologue of pterotic acid.

P. R. PAL and S. C. ROY, Calcutta.

A homologue of pterotic acid has been synthesized by replacing *p*-aminobenzoic acid moiety of the molecule by *p*-aminomethyl-benzoic acid through the condensation of 2,4,5-triamino-6-hydroxy-pyrimidine sulphate monohydrate, 2,3-dibromopropionaldehyde and *p*-aminomethylbenzoic acid under suitable conditions. The UV absorption spectra of the purified compound and the position at which the side chain is attached to the pteridine molecule have been determined.

The compound has also been tested microbiologically with respect to the growth of *Streptococcus faecalis* R.

#### 198. A New Method of Purification of Invertase from Brewer's Yeast.

M. M. BISWAS, Calcutta.

330 gms. of dried brewer's yeast were washed with distilled water to remove salts, carbohydrates and other soluble impurities. The residue was autolysed with

c.c. toluol for 4 days at 35°C. After autolysis the mixture was diluted with 450 c.c. ether and filtered with keiselguhr under suction. The filtrate was dried in vacuo and 5% solution of this powder was used for experiment. Adsorption was made with varying proportions of aluminium hydroxide gel and the adsorbed enzymes eluted with a buffer of pH 5.4. It was found that at 3 c.c. of aluminium hydroxide gel ( $\text{Al}_2\text{O}_3 = 5.43\%$ ) per 50 c.c. of 5% enzyme mixture the activity ratio of saccharase : diastase : raffinase in the eluted extract was 1:2.86:2.02. Maximum adsorption of diastase and raffinase was made at this concentration. Filtrate after this adsorption was dried in vacuo and gave an enzyme mixture highly rich in saccharase.

## 9. Stability of Vitamin A in Shark-liver oil emulsions.

A. SENGUPTA and D. K. ROY, Pilani.

Fish liver oils are rich sources of vitamins A and D. Generally these oils are better administered in emulsion form with preservatives and flavouring agents. It is well-known that vitamin A is more easily absorbed by the system if present in emulsion form in water. Vitamin A is not a very stable substance and the presence of water along with the increased surface area, as in emulsion stage, enhances the rate of deterioration, particularly through long storage in warm climates. With these ideas in view a number of anti-oxidants, e.g. gallic acid, glucose, ascorbic acid, ethyl gallate, hydroquinone, purogallol and sodium bisulphite and a few combinations of the above were experimented for preservation of vitamin by incorporating them in Shark-liver oil emulsions. Vitamin A values were determined by measuring the per cent transmission of light (Filter No. 630) through a blue coloured solution developed by the addition of a chloroform solution of the unsaponifiable matter of the oil emulsions to a chloroform solution of antimony trichloride with the help of a Lumitron photo-electric colorimeter (Model 401). These experiments were carried week by week. It was observed that glucose 0.1%, ascorbic acid 0.1%, hydroquinone 0.05% showed promising results and one mixture of ascorbic acid 0.1%, glucose 0.1%, and ethyl gallate 0.1% and another mixture of ascorbic acid 0.1%, glucose 0.1% and hydroquinone 0.05% showed a deterioration of vitamin A of the order of 28.8% and 21.8% respectively in contrast to 67.5% of plain emulsion after 16 weeks' storage at 37°C in a dark place.

## 10. Production of Fungal Diastase.

SHAGWAN S. LULLA, DYAL SINGH JOHAR and V. SUBRAHMANYAN, Mysore.

Comparative data has been obtained for the yields of mold diastase on wheat bran and lucerne media using a strain of *Aspergillus oryzae*. The diastase formation is maximum on wheat bran medium when one part of the bran is soaked with 1.5 parts of water and on lucerne medium when one part of it is soaked with 2.5 parts of water. The alcohol purified enzyme sample obtained from lucerne medium has not given a clean product fit for pharmaceutical purposes as compared to a product obtained from wheat bran medium. Fermentation residues left behind after the enzyme extraction have been reutilized for the growth of *Aspergillus oryzae* and highly amylolytic strain of *B. subtilis*. The residues by themselves are poor substrates to support the growth of micro-organisms but supplementation of these materials with their parent substrates considerably increase the enzyme formation. The possibilities have been indicated for utilizing similar residues obtained from bacterial diastase industry. A method for the production of an active mold bran preparation has been worked out. A purified enzyme sample prepared in this laboratory has been found to be 5 fold stronger than Taka-Diastase.



**201. Development of Amylase under submerged cultivation of *Aspergillus Oryzae*.**

BHAGWAN S. LULLA, DYAL SINGH JOHAR and V. SUBRAHMANYAN, Mysore.

Aqueous extract of gelatinized wheat bran has been employed as a source of culture medium for the submerged growth of *Aspergillus oryzae*. The formation of  $\alpha$  and  $\beta$ -amylases in this medium has been studied and it is found that the maximum concentration of  $\alpha$ -amylase takes place after 72 hours of mold growth and whereas maximum  $\beta$ -amylase activity is observed only after 120 hours incubation. Supplementation of this medium with various amino acids which gave weak spots on the paper chromatogram and various other nitrogen sources and carbohydrate rich materials have been studied. The paper chromatographic technique has been also employed for determining carbohydrates in the fermented medium at various intervals of mold growth. Number of un-identified spots have been located on the paper chromatogram. The optimum conditions for the mold growth and amylase formation have been investigated. The extraction of one part of bran material with ten parts of water has been found economical in the preparation of the bran medium.

**202. Studies on the Nutritive value of Synthetic Glycerides.**

R. C. BASU ROY CHOUDHURY, D. GANGULY and M. N. GOSWAMI, Calcutta.

The rate of absorptions as well as the coefficient of absorption of fat particles through the gastro intestinal tract is a very important factor in assessing the nutritional value of a fat or glyceride substance. Fat particles or glyceride molecules having low absorption coefficient cannot be nutritionally available. The absorption of glyceride particles depend on various factors and in that respect the different types of glycerides, namely the monoglycerides and the triglycerides, both simple and mixed may be expected to have different rates of absorption. Experiments were carried out with monobutyryl, monocaproin, tributyrin and tricaproin regarding their absorption in the gastro intestinal tract and differences are found in the absorption of the monoglycerides from the triglycerides. The work is proceeding with other types of monoglycerides and triglycerides.

**203. Effect of adrenal cortex on digestibility of a few fats in albino rats.**

D. MISHRA, Sambalpur (Orissa):

In the studies of nutritional aspect of fats the effect of adrenalectomy on fat absorption is of special interest because the effect might vary with different fats. Adult albino rats from breeding colony were selected as test animals and 30 out of 35 surviving adrenalectomized animals were divided into 5 groups. Similar five groups of normal animals were also selected along with the blank group with fat-free diet to determine the 'metabolic fat'. Mean average results of digestibility observed in normal animals are:—

Butter—96.5, Dalda Vanaspati—94.6, Crude Shaal Seed Oil—34.0, Refined Shaal Seed Oil—95.0, and Ground Nut Oil—95.2, whereas the same in case of adrenalectomized albino rats are:—

Butter—75.3, Dalda Vanaspati—65.5, Crude Shaal Seed Oil—67.5, Refined Shaal Seed Oil—68.2, and Ground Nut Oil—69.0.

**204. A micro-electrophoretic study of the interaction between sodium dodecyl sulphate and crystalline bovine plasma albumin.**

M. A. COHLY and M. R. A. RAO, Bangalore.

The reaction between sodium dodecyl sulphate (SDS) and crystalline bovine plasma albumin (BPA) has been studied in phosphate-saline buffer of pH=6.8 and

nic strength,  $\mu=0.05$  by electrophoresis at the room temperature. In Group I experiments the dialysed protein-detergent-buffer solution has been subjected to electrophoresis against buffer containing an equivalent amount of detergent and in Group II solutions the dialysed protein detergent buffer solution has been subjected to electrophoresis against pure buffer. The protein-detergent complex has even rise to a single boundary in both the limbs in group I and group II experiments for the different detergent protein ratios. It has been inferred from the study that a single complex has been formed having a very small dissociation constant. At a detergent-protein ratio of  $10^{-3}$  M however the complex shows asymmetrical movement in both the limbs in group II experiments and under prolonged electrophoresis three moving boundary gradients are obtained in the two limbs. This finding has not been reported in the literature so far and it has been assumed that the three boundaries represent 3 distinct complexes. The present study has also shown that the SDS-BPA reaction has a strong dependence upon SDS/BPA mixing ratio.

#### 205. Molybdenum content of some Indian Pulses.

P. P. NAIR and N. G. MAGAR, Bombay.

Twelve common Indian Pulses were examined for their Molybdenum content by thiocyanate method. The values obtained on an average ranged between 8-18  $\mu\text{g}/\text{gram}$ . Green gram and field beans, however, contained about 14  $\mu\text{g}/\text{gram}$ . Black gram showed exceptionally high quantities of Mo ranging up to 50  $\mu\text{g}/\text{gram}$ .

#### 206. Study of the visceral fat of Kan Mushi.

R. K. SHARMA and N. G. MAGAR, Bombay.

The Viscera of Kan Mushi (*Cestracion Blochii*) was subjected to cold saponification. The unsaponifiable fraction was examined for the presence of vitamin A and sterols spectrophotometrically. This fraction was further subjected to Swain's flowing chromatographic technique using Petroleum ether, carbon tetrachloride, ether and alcohol as eluents and then examined in the ultra-violet from 230 to 340  $\text{m}\mu$ .

The mixed fatty acids were subjected to low temperature crystallization. Component fatty acids were determined from the saponification equivalents, iodine values, isomerisation and bromo derivatives

#### 207. Isolation of the bound nicotinic acid from rice bran.

D. K. CHAUDHURI, Calcutta.

Studies on the isolation of the bound nicotinic acid from rice bran have been made. A purification of this substance has been attained with the help of repeated fractional precipitation with different solvents and using column chromatographic technique. The final product on being analysed for nicotinic acid gave the following results which show that the bound nicotinic acid is purified to the extent of about 130 times of the original material (Total nicotinic acid value = 0.3  $\text{mg}/\text{g}$ ):

(1) Nicotinic acid value before digestion = 10.53  $\text{mg}/\text{g}$ .

(2) Nicotinic acid value after digestion (total) = 40.27  $\text{mg}/\text{g}$ .

(3) Factor "f" =  $\frac{\text{Value under (2)}}{\text{Value under (1)}} = 3.83$ .

The value for factor "f" given above suggests, according to Chaudhuri (Science and Culture, 17, 270, 1951) that all the nicotinic acid in the purified product is in



the combined state. It may also be noted that the final precipitate when observed under microscope at a magnification of 80-fold looked somewhat like round-shaped.

This purified material is brown in appearance, soluble in dilute acid, dilute alcohol, and dilute acetone and insoluble in ether, chloroform, petroleum ether etc. Tests for the presence of proteins were done which gave positive results. Theoretically, the molecular weight is calculated to be 3054 taking into consideration that one molecule of nicotinic acid is bound up with the rest of the molecule.

## 208. Biogenesis of Ascorbic Acid.

M. N. RUDRA, Laheriasarai.

Various factors and the probable mechanism of conversion of the sugar precursors into ascorbic acid have been described. The possibility of ascorbic acid synthesis in man and guinea pig has been discussed. The probable mode of action of chloretone and other narcotics in accelerating ascorbic acid synthesis in animals has been suggested.

## 209. Biosynthesis of ascorbic acid and prevention of glycogen depletion in Liver and Muscle.

M. C. NATH and C. H. CHAKRABARTI, Nagpur.

Injection of sodium acetoacetate in low concentration (up to 200 mg/kg.) has been found to stimulate biosynthesis of ascorbic acid in rats and not to disturb carbohydrate metabolism by way of raising blood sugar level.

This compound at higher concentration (600 mg/kg.), however, depressed such biosynthesis, raised blood sugar and depleted liver and muscle glycogen in rats.

Sodium  $\beta$ -hydroxybutyrate depressed the biosynthesis of ascorbic acid in rats.

Rabbits failed to synthesize ascorbic acid after acetoacetate or  $\beta$ -hydroxybutyrate injection.

Depression in biosynthesis of ascorbic acid in animals has been shown to be associated with disturbance in carbohydrate metabolism.

## 210. Amino acid composition of the mycelia of *Streptomyces griseus* formed during its production of vitamin B<sub>12</sub>.

S. GANGULY and S. C. ROY, Calcutta.

The amino acid composition of the mycelia of *Streptomyces griseus*, has been determined by the unidimensional descending paper chromatographic method at different periods during the fermentative production of vitamin B<sub>12</sub>.

Valine, proline, methionine, leucine, alanine, glycine, serine, glutamic acid and aspartic acid have been identified and their individual concentration has been found to increase progressively up to the first three days, after which there is a sudden drop with the onset of the autolysis of cells.

## 211. Concentration of some B-vitamins in the Liver Tissue of Rats under Chloretone.

N. C. GANGULI and S. C. ROY, Calcutta.

The normal synthesis of ascorbic acid by rats can be greatly stimulated under chloretone. The effect of chloretone on the reserve of thiamin, riboflavin, nicotinic acid and vitamin B<sub>12</sub> in the liver tissue of rats has been studied. Of

these only vitamin B<sub>12</sub> content was considerably reduced while the others remain unaffected.

## 212. Chemical effects of ionizing radiations on solutions of Nucleic Acid, Purine and Pyrimidine bases by Spectroscopic Method.

N. S. RANADIVE, K. S. KORGONKAR and N. B. SAHASRABUDHIE, Bombay.

The effects of ionizing radiations on ribose nucleic acid in solution are not yet well understood. A few of the end products such as ammonia, free phosphates and free sugars have only been detected. It is not yet clear as to what are the chemical reactions that intervene between the primary process of ionization and the final end products. One of the methods to study this problem would be to test the relative radio-sensitivities of different constituent groups of the much complex RNA molecule and to ascertain the factors which influence this radio-sensitivity. The present paper is an attempt in this direction. Solutions of ribose nucleic acid, adenine, guanine, uracil, cytosine and thymine were prepared in suitable concentrations of HCl and NaOH solutions to get desired pH. The concentration ranges were between 0.001% to 0.03%. For irradiation, 25 c.c. of solution under investigation was usually taken in a 25 c.c. round bottom flask and a radon capillary tube of known strength was directly placed inside the flask. Investigations on the configurational changes in small volumes of dilute solutions necessitated the use of Absorption Spectrophotometric technique. Results of these investigations show a gradual destruction of RNA and the bases on irradiation. The radio-sensitivity among the different bases is found to differ and in some cases varies with pH.

## 213. Observations on the action of papain on casein.

RAMAPRASAD BANERJEE and SUDHISH NANDY, Calcutta.

Activated papain (H<sub>2</sub>S, HCN) acting on a 6.8 per cent casein sol. results in a decrease in viscosity as expected. With very dilute solutions of the enzyme, however, the initial rapid drop in viscosity is not observed. Instead, the viscosity reduction is preceded by a lag period during which the viscosity remains almost constant. The duration of the lag decreases as the concentration of the enzyme increases and almost disappears with concentrated preparations.

The plot of reduced viscosity  $\left( \frac{1}{c} \ln \frac{\mu}{\mu_0} \right)$  against concentration (c) of a solution of casein gives a straight line with considerable slope to the concentration axis, indicating thereby significant interaction with solvent or mutually with solute. The same solution of casein is allowed to be acted upon by a dilute papain solution and precipitated at the isoelectric point immediately after the completion of the lag period (7.8 minutes). The precipitated casein is purified and brought into solution. A plot of the reduced viscosity against concentration using this material gives a straight line almost parallel to the concentration axis. This would seem to indicate a radical modification of the protein-solvent relationship brought about by the dilute papain solution in the first few minutes corresponding to the lag period.

The few peptide linkages broken in the initial stage may result in a partial uncoiling of the highly coiled casein chain and a modification of the extent of solvent interaction would result. The action not found with trypsin may be understood from the known presence in commercial papain of several enzymes showing between them all kinds of exo- and endopeptidase activity.



## INDUSTRIAL CHEMISTRY

- 214. Utility Plastic from liquid refuse, Fêna (gruel) after cooking of rice and Refuse of Tea-leaves and Tea-dusts after decoction for the liquor in preparing tea.**

BINAYENDRA NATH SEN, Burdwan.

A kind of utility plastic has been prepared from two inevitable wastes common life, namely, the liquid refuse bi-product, Fêna (gruel) obtained from cooking of rice grains in the preparation of Bhâta (Sans. Anna) and the refuse of tea leaves and dusts after decoction for the liquor in preparing tea. The method is cheap and readily followed; and consists in digesting warm a prepared paste of tea leaves and dusts with 'ripened' Fêna in presence of alum and benzoic acid. The kind of plastic is of utility in preparing dolls and buttons and besides speaks of possibilities.

- 215. Solvent Segregation of Linseed Oil and Safflower Oil by Ethyl Alcohol.**

T. N. MEHTA, B. Y. RAO and M. P. KULKARNI, Nagpur.

The solvent segregation of the mixed glycerides of linseed oil and safflower oil with ethyl alcohol has been studied. The higher unsaturated glycerides having 6 to 7 double bond linkages can be extracted by ethyl alcohol. The equilibrium diagram has been drawn on rectangular co-ordinates for liquid-liquid extraction of linseed oil by ethyl alcohol and the performance of the counter-current multi stage extraction has been given. The results obtained by stepwise extraction of linseed oil by ethyl alcohol have been compared with those obtained by crystallisation from acetone at low temperatures by Hilditch and Seavell and by Chromatographic Method by Walker and Mills. It has been found that the extraction of safflower oil by ethyl alcohol has got limitations and the glycerides of it cannot be segregated.

- 216. Studies in Wrinkle Finishes. Part I.**

BALRAJ AJMANI and A. N. SAHA, Calcutta.

The effect of concentration of tung oil on the wrinkling of varnish films has been studied. A copal varnish (48.5% non-volatile) containing 25% tung oil and 77% stand oil (4.8 poise) wrinkles. From the observations made on the coated microscopic slides it was found that the wrinkling tendency gradually changes from a haphazard fashion to a regular one with the decrease of tung oil concentration and ultimately vanishes when concentration of tung oil is 22% and that of stand oil 78%. The eleostearic acid content of the tung oil used was 79%. Thinner used was toluene.

Thickness of the film at which the wrinkling occurs varies with the tung oil concentration. Higher the tung oil percentage less is the thickness required. The effect of other oils, resins and thinners is being examined.

- 217. Viscosity and Critical Solution Temperatures of some Oil Mixtures.**

B. P. GYANI and MADAN MURARI, Patna.

The viscosity of castor oil and its mixtures with benzene, alcohol, kerosene and diesel oil has been determined. The effect of temperature on viscosity of castor oil and acetylated castor oil has been studied and the heats of activation of viscous flow have been calculated. Critical solution temperatures of castor oil

with kerosene and diesel oil have been obtained. It is shown that the viscosity  $\mu$  of mixtures of castor oil with the above named liquids (concentration of castor oil =  $c$ ) is given by a simple equation,  $\frac{\mu}{c} = \frac{ab\mu}{1+b\mu}$ .

#### 218. Chemical study of the oil of Radish Seed.

S. P. PATHAK and V. N. OJHA, Banaras.

Raphanus Sativus, known in Hindi as Mooli and in English as Sadish seed, is of the genus Cruciferae. Its seed oil was systematically studied by Ester fractionation technique for the fatty acid composition.

It contains Palmitic 3.82, Stearic 2.14, Arachidic 0.51, Behenic 2.26, Lignoceric 0.36, Hexadecenoic 23.1, Oleic 10.6, Linoleic 12.5, Eicosenoic, 19.14, Erucic 25.5 per cents.

The composition shows that the oil is similar to other oils of the Cruciferae family, except the high percentage of hexadecenoic acid and Eicosenoic acids. The incidence of hexadecenoic acid gives the oil its importance, as the acid was reported rare in the vegetable oils and predominant only in animal kingdom in good amount.

#### 219. Studies on Dehydration of Castor Oil. Part I.

DIPTI KALYAN CHOWDHURY and B. K. MUKHERJI, Calcutta.

With a view to study the behaviour of constituent fatty acids during dehydration of castor oil, samples of the oil have been prepared by solvent extraction of the seed using, hexane, benzene and trichlorethylene followed in each case by extraction of the residual meal with absolute ethanol. The products obtained have been found to be of varying ricinoleic acid content and the amount of oil extracted in each case was also different. Hexane extract gave 54% of an oil with Iodine Value (Wij's 30 mins.) 85, H.V. 142, and 80.1% ricinoleic acid content. The benzene extract gave 73.78% of an oil having I.V. 83, H.V. 152, and ricinoleic acid 84.6%. The trichloroethylene extract gave only 46.8% of oil with I.V. 86.4, H.V. 150, and ricinoleic acid content 83.8%. The ethanol extract of the residual meals in the respective cases contained 95.9%, 97.5%, and 91.4% ricinoleic acid.

#### 220. Studies on Dehydration of Castor Oil. Part II.

DIPTI KALYAN CHOWDHURY and B. K. MUKHERJI, Calcutta.

The samples of castor oil obtained by methods described in Part I were dehydrated at 250°C under partial vacuum in an atmosphere of nitrogen using 1% NaHSO<sub>4</sub> and 1% KHSO<sub>4</sub> on the wt. of oil. Samples were withdrawn during dehydration at definite intervals of time and their Mol. Wt. and Iodine Values were determined and the composition of their mixed fatty acids liberated after saponification were analysed by modern methods of spectrophotometric technique. It has been observed that the higher the proportion of ricinoleic acid in the original oil the greater is the degree of polymerisation. The proportion of dienoic acid in the original oil does not affect the degree of polymerisation to as much an extent as ricinoleic acid. This would suggest that the dienoic acid as obtained by the dehydration of ricinoleic acid, plays a more important role during polymerisation than the dienoic acid originally present. The dehydration proper is mostly completed within the first 60 minutes of dehydration after which the dienoic acids produced tend to be transformed into its conjugated isomer and to get polymerised.



**221. Studies on Sulphonation of Modified Oils.**

ARUN KANTI DUTTA and B. K. MUKHERJI, Calcutta.

The present investigation reveals that products obtained by sulphonation of certain oils after glycerolysis and ethanolysis serve as very good substitutes for Turkey Red Oil so far as the lowering of oil to water interfacial tension is concerned. The oils investigated were ground-nut, Polang and Sardinefish oil. The relative merit of the sulphonated products in lowering the interfacial tension depends on the extent of hydroxyl groups present as mono- and di-glycerides in ethanolyse and glycerolised oils. The degree of glycerolysis seems to depend on the nature and proportion of the constituent fatty acids of a particular oil.

Sulphonated ethanolyse ground-nut oil (freed from ethyl esters) was found to have a better inter-facial tension lowering property than Turkey Red Oil, while that of sulphonated glycerolised ground-nut oil was equivalent to Turkey Red oil. Sulphonated glycerolised Polang and Sardine-fish oils were somewhat inferior to Turkey Red oil. 0.5183, 0.5042, 0.5123, 0.5201, 0.5206 gm. of sulphonated Castor, ethanolyse ground-nut (free from ethyl esters), glycerolysed ground-nut, glycerolyse Sardine-fish and glycerolysed Polang oils respectively dissolved in 100 gms. of ground-nut oil showed inter-facial tensions of 5.4, 3.7, 5.2, 8.5 and 7.3 dynes per cm respectively measured against water at 30°C in Cenco-du-Nöuy tensiometer.

**222. Studies in Flaky Graphite—Part I.**

K. K. MAJUMDAR, Dhanbad.

Flaky graphite is largely used as refractories and lubricants. A survey has been made for locating the possible sources of flaky graphite in India, and flakes have been produced from them. It has been found that the chief sources are the Khondalite series of rocks in Orissa and the product mined is a mixture of flaky and amorphous graphite. Suitable flakes have been produced by selective crushing and grinding followed by treatment in smooth crushing rolls to release the flakes. The carbon content and general appearance of the flakes improved considerably by washing the flakes. The flakes have come up to standard specifications, so far as carbon content is concerned. Graphite from Patna State in Orissa yielded about 10 to 12 per cent flakes only from run-of-mine ores.

**223. Studies in Flaky Graphite—Part II.**

K. K. MAJUMDAR, Dhanbad.

Indian flaky graphite has been tested for its ash content and nature of ash, bulk density or 'Flakiness Index', and particle sizes, to evaluate its usefulness as a crucible grade product and has been compared with U.S. and British specifications. No Indian Standard Specifications have been drawn till now for this variety, and it is hoped that the present paper will throw some light on the properties of flaky graphite of this country. It has been found that, in general, the flakiness index of Indian graphite is rather low, being around 100 for -14 +48 mesh particles, whereas the corresponding value for Madagascar graphite flakes being 129. In other respects Indian flaky graphite compares favourably with Madagascar graphite.

**224. Separation of Sodium from Potash Liquor from Felspar Employing Ion exchange Technique.**

ESHWAR RAJ SAXENA and D. S. DATAR, Hyderabad (Dn.).

A simple ion-exchange method for the separation of sodium from potassium is described. The technique can be applied for the separation of sodium impurity from

potassium sulphate or potassium bromide obtained from potassic felspar. The method has an advantage over the usual fractional crystallization process in that it is less tedious and the separation is complete. The possibility of using this method for determination of sodium, for which no suitable method exists, is also indicated.

#### 225. Pure Potassium Bromide from Nellore Felspar.

ISHWAR RAJ SAXENA and D. S. DATAR, Hyderabad (Dn.).

Potash felspar from Nellore (Andhra) with low soda content has been utilized for the recovery of potassium hydroxide by the 'digestion method'. The potash liquor thus obtained is used for preparing potassium bromide. The possibility of using ion-exchange technique for complete separation of sodium from potassium bromide is discussed.

#### 226. Action of steam on Chitaldrug (Mysore) Pyrites.

K. N. MOORTHY and D. S. DATAR, Hyderabad (Dn.).

The analysis of Chitaldrug (Mysore) pyrites is given and the action of steam on the pyrites is studied. The reaction starts at 600°C. Iron pyrites is reduced to Iron sulphide, 17% of Iron sulphide being produced by heating Iron pyrites in steam for 2½ hours. Both sulphur dioxide and hydrogen sulphide are evolved simultaneously and continuously. Whereas in the reaction of coal pyrites and steam already reported Iron sulphide is formed in traces and sulphur dioxide is given out only in the earlier stages of the reaction.

#### 227. Decomposition of Tricalcium Phosphate in presence of Sodium Carbonate and Alumina.

(Miss) AKTAR MOHAJIR and D. S. DATAR, Hyderabad-Dn.

When tricalcium phosphate, alumina and sodium carbonate are heated at 900°C, a portion of calcium phosphate is decomposed liberating phosphorus pentoxide, which either forms water soluble sodium phosphate by reacting with sodium carbonate or escapes as such. Sodium carbonate accelerates the reaction as it melts at 851°C and the mixture acquires liquid consistency which facilitates the decomposition of the phosphate and the formation of monocalcium tetrasodium phosphate by reaction between calcium phosphate and sodium carbonate. The fluor-apatite structure is broken and the resulting product is completely soluble in 2% citric acid.

#### 228. Active carbon from Coke obtained by low temperature carbonisation of Singareni Coal.

T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad-Deccan.

'Coalsite' which is the low temperature coke obtained by the carbonisation of Singareni coal is used for the preparation of active carbon using air activation process. The optimum product with maximum methylene blue and iodine adsorptions is obtained when the loss of weight is 57% and the temperature of activation 350-400°C. Further heating does not increase the activity. The methylene blue adsorption bears a linear relationship with the percentage loss of weight of the activated product.



**229. Studies on Caramel Decolorisation by Active Carbons from Indigenous Materials.**

T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad (Dn.).

Active carbons prepared from groundnut hull, teak wood saw dust and 'Coalsite' under suitable conditions of activation and temperature exhibit good decolorising property for caramel. The percentage caramel decolorisation bears a linear proportionality with the methylene blue adsorption. The caramel decolorisation of the samples is somewhat lower than the B.D.H. active charcoal but higher than the Norit.

**230. Studies on Vapour Adsorption by Active Carbons prepared from Indigenous Materials.**

T. L. NARASIMHA RAO and D. S. DATAR, Hyderabad-Deccan.

The vapour adsorption determinations were done for active carbons prepared from groundnut hull, teak wood saw dust and 'coalsite' as raw materials. The adsorption and retentivity of vapours of benzene, acetone and carbon tetra-chloride, with an air flow rate of 35 ml. per minute were studied at 35°C. The adsorption values are comparable to the commercial samples.

**231. Solvent Extraction of Vegetable Oils—Part I. Solubility of Safflower Oil in ethyl alcohol.**

K. RAMALINGAM and K. S. CHARI, Hyderabad-Dn.

The importance of the establishment of Solvent Extraction industry for edible and non-edible vegetable oils using an indigenous solvent like ethyl alcohol is stressed. The first step for the proper design and operation of solvent extraction unit using alcohol as a solvent, is the necessity of obtaining data on the solubility of oils in alcohol. The present investigation deals with the solubility of safflower oil in ethyl alcohol of various concentrations and at various temperatures. The saturation solubilities of safflower oil between 40°—100°C in 85—99.94% ethyl alcohol were determined. It was found that the oil is completely miscible in 95.75% alcohol at 90°C and in absolute alcohol at 70°C.

**232. The seed fat composition of Albizzi Lebbek.**

ANUPAM SEN GUPTA (Pilani), S. R. CHAKRABARTY and M. M. CHAKRABARTY, Calcutta.

The seed fat composition of Albizzi Lebbek Benth (Bengali and Hindi—Sirish), N.O. Leguminosae, a tree used in a large scale for afforestation purposes in the desert areas of Rajasthan has been studied with modern spectrophotometric technique. The dark brown coloured oil had the following characteristics S.E. 294.3; I.V.—104.1;  $n_D^{40}$ —1.4683; N.S.—1.6%. The component fatty acids found by spectrophotometric analysis were % linolenic—1.5; % linoleic—50.8; % Oleic—13.2; % Saturated—34.5. The present analysis differs from a previous one by Grindley who found 28% linoleic; 43% Oleic and 29% saturated acids.

**233. Studies on the low temperature carbonisation of South Arcot lignite and on the properties of the products obtained.**

S. SUBRAHMANYAN and A. P. MADHAVAN NAIR, Madras.

As a part of comprehensive study of the properties of South Arcot lignite and of the various products derived from it, low temperature carbonisation assays were

performed at six temperatures in the range 500°C—750°C. The proximate analysis of the lignite gave 15.7% moisture, 48.8% volatile matter, 3.28% ash and 22.2% of fixed carbon. The calorific value was found to be 11090 B.t.u./lb. on the dry basis. The yields of the char were found to decrease with increasing temperature in the above range tending to become constant at higher temperatures. Yields of tar and of gas increased with temperature. Quicker rate of heating gave a higher percentage of gas. The yield of ammonia was low (<0.5%). The gas had a calorific value of 400 B.t.u. per cu.ft. The proximate analysis and the physical constants of the tar were determined. Primary distillation of the tar gave 5 fractions and a residue of pitch. The phenols were separated and fractionated. The neutral washed oils were redistilled and the percentages of the fractions estimated. The results are summarised below.

Crude phenols=19.3%; Benzol, Toluol and naphthas=2.4%; Creosote oil=22.5%; Crude paraffin wax=14%; Pyridine and anthracene in traces; Naphthalene—Nil; Pitch=26%.

### 234. Thermal Polymerization of Dehydrated Castor Oil.—II.

K. K. DOLE and V. R. KESKAR, Poona.

Effect of hydrolysis produced during the dehydration of castor oil, on the thermal polymerization of the oil is studied in this paper. The side reaction of hydrolysis occurs in all attempts of dehydration of castor oil no matter which catalyst is used; the difference is of the degree of hydrolysis. Some catalysts give D.C.O. with the acid values of the order of 10 units, while some others give acid values as high as 40 units. It is observed that D.C.O. of high acid value, though rich in unsaturation, is very slow in polymerization. The cause of this phenomenon can be attributed to the low functionality and consequently low polymerization potential of the molecule. Further, it is seen in such cases, that there is a rapid fall in the iodine value without corresponding increase in the molecular weight, showing thereby, that some other reaction of the intramolecular condensation type is taking place. Small traces of catalysts, remaining in the oil, may be catalysing this reaction. The increase in the refractive index is also somewhat abnormal.

### 235. Study of Active Charcoal prepared from Euphorbia Tirucalli L. (Sher).

K. K. DOLE and P. K. GODBOLE, Poona.

Active charcoals prepared by using different activating agents—(1) Zinc chloride and hydrochloric acid, (2) Boric acid and carbon dioxide and (3) carbonates of sodium, potassium, calcium, strontium and barium are studied in more details.

Adsorption and desorption of iodine and sulphanilamide are studied. Iodine is desorbed to the extent of more than 70% and sulphanilamide is desorbed to the extent of nearly 50%.

Heat of wetting, adsorption of benzene and its retentivity are studied. In some charcoals, the heat of wetting is found as much as 48 to 50 calories per gram of charcoal. Heat of wetting is a function of retentivity of charcoal rather than of its adsorptive capacity.

### 236. Studies in the Film Properties of D.C.O. Varnishes.

K. K. DOLE and D. M. DESHPANDE, Poona.

Castor Oil is dehydrated using different catalysts. The dehydrated samples are used to prepare oleoresinous varnishes using a modified phenolic resin. Varnishes of different oil lengths are prepared using different D.C.O. samples. Similar



varnishes were prepared with double boiled linseed oil using the same resin. Film properties such as drying time, resistance to cold water, resistance to acid, alkali and organic solvents of the D.C.O. varnishes are studied and they are compared with those of the double boiled linseed oil varnishes. It is shown that D.C.O. varnishes are superior to linseed oil varnishes in alkali resistance and that they compare very favourably with linseed oil varnishes in water resistance, resistance to acid and resistance to organic solvents.

### 237. Studies on the Solubility of Dehydrated Castor Oil.

K. K. DOLE and V. R. AMBEKAR, Poona.

Castor oil is soluble in ethyl alcohol, but on dehydration it becomes insoluble in the same solvent even at the boiling point of the solvent. Isopropyl alcohol, which is less polar than ethyl alcohol, dissolves dehydrated castor oil completely at slightly elevated temperature.

It is observed that different catalysts produce samples of dehydrated castor oil depending upon various conditions such as, reaction temperature, period of reaction, pressure, and rate of removal of reaction products. Solvent isopropyl alcohol shows different solubility temperatures with different samples depending upon the side reactions of polymerisation, decomposition, hydrolysis, isomerization, estelide formation, taking place along with dehydration. In general samples under reduced pressure have higher solubility temperatures than the samples at atmospheric pressure. Increased polymerisation and unsaturation increases the solubility temperature. Incomplete dehydration, greater decomposition and hydrolysis lowers the solubility temperature.

### 238. Dehydration of Castor Oil with Phenol Trisulphonic Acid as Catalyst.

K. K. DOLE and V. A. SARAF, Poona.

Phenol-tri-sulphonic acid is a very active catalyst for the dehydration of castor oil. It is active at 200°C, both under atmospheric as well as under reduced pressures. The quantity of the catalyst required to effect complete dehydration is quite small. Under reduced pressure, as little as 0.075 per cent of the catalyst is sufficient to give complete dehydration (I.V. (Wöb)=156.9) at 200°C.

When the activities of mono-, di- and tri-sulphonic acids of phenol are compared, it is found that :

- (i) The time required for the dehydration of castor oil by phenol-di-sulphonic acid is half that required by phenol-mono-sulphonic acid. The iodine values (Wöburn method) of the dehydrated product by using the former as the catalyst is 145.4 as against an iodine value of 134.0 when the latter is used as catalyst—percentage and temperature of reaction being kept the same (0.3 per cent and 250°C).
- (ii) Phenol-tri-sulphonic acid is however active at 200°C. It gives an iodine value of 153.4 when 0.15 per cent of it is used at 230°C for 20 minutes under atmospheric pressure.

### 239. Monocalcium Tetra Sodium Phosphate—Part II.

Miss AKHTAR MOHAJIR and D. S. DATAR, Hyderabad-Deccan.

As in the case of the reaction of rock phosphate with alkali carbonate, monocalcium tetra sodium (or potassium) phosphate is produced by heating rock phosphate with alkali hydroxide. For maximum reaction, 4 mols. of alkali hydroxide per mol. of tricalcium phosphate are necessary.

The reaction temperature in case of hydroxides is 340-400 while with carbonates it is about 900°C. The experiments show that the reaction takes place at a temperature near the melting point of the alkali compound. It is probable that at the melting point alkali compound decomposes with the liberation of alkali oxide which penetrates into the lattice of tricalcium phosphate structure. It is seen that four alkali oxide molecules thus displace two calcium oxide groups from the phosphate structure in one stage.

#### 240. Mono Calcium tetra sodium phosphate—Part I.

MISS AKHTAR MOHAJIR and D. S. DATAR, Hyderabad-Dn.

Mono calcium tetra sodium or potassium phosphate is obtained by heating rock phosphate or tricalcium phosphate with alkali carbonates at 900°C. The optimum proportion is two mols. of alkali carbonate to one mol. of tri calcium phosphate. The product is soluble in neutral ammonium citrate solution. The mixed salt is not soluble in water and is not hydrolysed but the reaction takes place with a little formation of water soluble phosphate. In the case of potassium carbonate, however, the tendency to form water soluble phosphate is negligible.

The maximum yield of the mono calcium phosphate from phosphate rock is 73.6% with sodium carbonate and 74.1% with potassium carbonate.

#### 241. Fuller's earths from Hyderabad State, their occurrence and Bleaching Properties.

S. S. JOSHI and S. A. SALETORE, Hyderabad-Dn.

Fuller's earth occurs in the State mainly in two areas one lying in Tandur taluk and the other in Chincholi taluk of Gulbarga district. Fuller's earth obtained in Tandur taluk i.e. at Gingurti has been prospected and hence the work on same was undertaken after collecting representative samples from the above place. Its properties and the probabilities of its industrial use were studied. Samples from Chincholi taluk were picked up, were activated and their adsorption properties were tested. These activated earth samples compared well with the foreign samples used for the removal of colour from groundnut oil in oil industry.

*Occurrence* :—Fuller's earth occurs in plenty in Chincholi taluk spread over in extensive beds in various localities. These places are Chincholi, Chime-idlai, Dastapur, Korvi and Sulehpeth. So far these areas have not been prospected but from a general survey it can be roughly estimated to yield approximately 3 to 4 million tons of raw earth. Some of these deposits are contaminated with calcareous materials and the others are contaminated with alluvial black cotton soil.

#### 242. Studies of some seed fats of Cucurbitaceae family—Part V.

D. K. CHOWDHURY, M. M. CHAKRABARTY and B. K. MUKHERJI, Calcutta.

##### *The seed fat of Cucumis Sati Vas.*

The seed fat composition of *Cucumis Sativas* (Eng. Cucumber, Bengali - Shasha) has not been hitherto investigated by modern Spectroscopic methods. The seeds on extraction with Petroleum ether yielded 31.3% clear yellow oil, the characteristics of which have been studied.

The mixed fatty acids of the oil were analysed by Spectrophotometric methods according to the technique of Hilditch and coworkers and the composition computed from this were as follows :—

Linoleic acid	...	...	...	52.43%
Oleic acid	...	...	...	34.34%
Saturated acids	...	...	...	13.23%



From the results of the analysis it is apparent that the seed fats from *Cucumis Sativa* follow the normal trend of the members of the Cucurbitaceae family in not containing any conjugated and non-conjugated triene acids and are more similar to members like *Cucurbita maxima*, *Benincasa Cerifera*, *Lagenaria Vulgaris*, *Citrullus Vulgaris* etc. The oil if available in commercial quantities will be utilisable in edible, soap and hydrogenation industries.

**243. Studies on Some Seed Fats of Cucurbitaceae Family—Part VI. Component Fatty Acids of the Seed Fat from *Momordica Charantia* Linn. Variety—*Muricata* (Bengali—Ucché).**

DIPTI KALYAN CHOWDHURY, M. M. CHAKRABARTY and B. K. MUKHERJEE  
Calcutta.

The component fatty acids of the seed fat from *Momordica Charantia* Linn. variety—*Muricata*, has been investigated by the most modern methods of low temperature crystallisation and ultra-violet absorption spectrophotometry coupled with micro-fractionation of the methyl esters of the saturated fatty acids. The mixed fatty acids were separated into three fractions (A) having no Iodine Value (18%), (B) (34.7%), and (C) (47.3%), the composition as arrived at by computation of the analyses of the different fractions were: conjugated triene (expressed as  $\alpha$ -elaeostearic acid)—48.49%, linoleic—8.83%, oleic—12.21% and saturated—30.47%. The fractionation of the saturated fraction revealed that the saturated acids were mostly composed of stearic acid with minor quantities of palmitic and arachidic. The present results differ markedly from an earlier investigation of Airan and Shah who found 83.7% of oleic acid and 16.3% of stearic acid without recording the presence of any diene or triene acids. It has been suggested that the conjugated triene acid is present as trichosanic acid as in some other members of the Cucurbitaceae family. The possibility of the use of this oil in industry has been mentioned.

**244. Studies on Some Seed Fats of Cucurbitaceae Family—Part VII. Component Fatty Acids of the Seed Fat from *Momordica Charantia* Linn. Variety—'Proper' (Beng.—Karala).**

DIPTI KALYAN CHOWDHURY, M. M. CHAKRABARTY and B. K. MUKHERJEE,  
Calcutta.

The component fatty acids of the seed fats from *Momordica Charantia* Linn. hitherto have not been reported with particular reference to the two predominant varieties. The composition of seed fat from the variety known as *muricata* is being reported in another communication of this series. The composition of seed fat from the variety proper (Beng. Karala) is here reported. The seeds from ripe fruit on extraction with petroleum ether yielded 32.8% of a clear light yellow oil having the following characteristics. Ref. Ind. at 28°C—1.4899, Sap. Equiv.—301.5, Iodine Value (Wij's 30 mins.)—123.5%, Non-sap.—1.4%, Free fatty acids—0.9 (as oleic). The mixed fatty acids on investigation according to the methods of Hilditch et al., employing the methods of ultra-violet absorption spectrophotometry gave the following figures—% conjugated triene—40.34, % linoleic—18.48, % oleic—15.28, (due to presence of conjugated acids the p.c. of oleic acid was computed from the figures of saturated acids determined by Bertram's oxidation.) % saturated—25.90. The fatty acid composition of this variety is in general similar to the other variety (*muricata*) as found in this series of investigation, but differs markedly from a report of Airan and Shah who could not detect the presence of more unsaturated acids than oleic. The possibility of the oil in paint industry has been discussed.

**245. Studies of some seed fats of Cucurbitaceæ family—Part VIII. The component fatty acids of *Tricosanthes Anguina*.**

DIPTI KALYAN CHOWDHURY, M. M. CHAKRABARTY and B. K. MUKHERJI, Calcutta.

The fatty acid composition of the oil from *Tricosanthes Anguina* Linn. (English Snake gourd, Bengali—Chichinga) belonging to the natural order cucurbitaceæ has been investigated by the modern methods of spectrophotometric technique. The seeds yielded 29.9% of clear oil of the following characteristics viz. Ref. Index at 25°C.—1.4854, Sap. Equivalent—300.6, Iodine value (Wij's 30 min.)—108.7, Per cent free fatty acid as oleic—0.6. The mixed fatty acids from the oil were analysed spectrophotometrically and the saturated acids were determined by Bertram's oxidation. The component fatty acids as computed from these were as follows:—Conjugated triene acids estimated as  $\alpha$ -eleosteric 25.9, Linoleic acid 21.3, Oleic acid 32.1, Saturated acid 20.7. The results however differ markedly from those of a previous analysis by Soni and Aggarwal.

**246. Studies on Jute Seed Oils.**

A CHAKRABARTY, S. R. CHAKRABARTY, M. M. CHAKRABARTY and N. K. SEN, Calcutta.

Three specimens of Jute seed oil obtained from Alipur Duars and J.A.R.I., Barrackpore, West Bengal have been studied to investigate the variation in the composition depending on environmental factors. The sample from Alipur Duars and one of the samples from Barrackpore were of '*Corchorus Capsularis*' variety. The other sample from Barrackpore was of '*Corchorus Olitorius*' variety. The samples of *C. capsularis* obtained from two different places were found to have almost the same fatty acid composition viz., 2.9—3.1% Linolenic, 66.2—67.3% Linoleic, 1.0—2.8% monoethenoid acids and 28.1—28.6% saturated acids. The results differ markedly from analysis of another sample of *C. capsularis* investigated by Sen and Meara. The composition of *C. olitorius* was found to be:—1.6% linolenic, 66.2% linoleic, 9.8% monoethenoid acids, 26.0% saturated acids. The result of this analysis, however, is more or less the same with those of Sen and Meara. From the result of this experiment it can be stated that application of modern technological methods such as solvent extraction and solvent segregation might make available to the Oil Industry yet another source material for industrial use.

**247. Studies on Some Seed Fats of Cucurbitaceæ Family—Part IX. Component Fatty Acids of the Seed Fat from *Luffa Acutangula*. (Beng.—Jhinga).**

DIPTI KALYAN CHOWDHURY, M. M. CHAKRABARTY and B. K. MUKHERJI, Calcutta.

The seed fat composition of *Luffa Acutangula* (Beng. Jhinga) has been investigated by the modern methods of spectrophotometric analysis for the first time. The seed fat was obtained by extracting the ripe dried seeds with petroleum ether. The seeds were found to contain 19.9% of a clear light brown coloured oil, having the following characteristics:—Ref. Index at 25°C.—1.4681, Sap. Equivalent—297.6, Iodine Value (Wij's 30 mins.)—95.7 per cent, Non-sap.—1.0 per cent, Free Fatty Acids—1.1 (as oleic). The mixed fatty acids on analysis were found to contain linoleic acid—37.09%, oleic acid—38.78%, and saturated acids—24.13%. The result of this analysis varies from that obtained by Pieraerts and de Winter (Ann. Mus. Colon. Marseille, 36, No. 6, 5, 1928). The present result appears to be more accurate on account of the modern methods employed. *Luffa Acutangula* possesses the



normal trend of the seed fats of Cucurbitaceae family in containing no conjugated or non-conjugated triene acids. The uses and commercial possibilities of the oil have been indicated.

**248. Studies on Some Seed Fats of Cucurbitaceae Family—Part X. Component Fatty Acids from the Seed Fat of *Luffa Aegyptiaca* (Beng.—Dhundhul).**

DIPTI KALYAN CHOWDHURY, M. M. CHAKRABARTY and B. K. MUKHERJEE  
Calcutta.

The seed fat composition of *Luffa Aegyptiaca* (Bengali—Dhundhul) has been investigated by the modern methods of spectrophotometry. The ripe dried seeds, on extraction with petroleum ether (B.P. 40°-60°C) yielded 20.3% of a clear light brown coloured oil having the following characteristics:—Refractive Index at 25°C—1.4672, Sap. Equivalent—296.3, Iodine Value (Wij's 30 mins.)—112.4, per cent non-sap.—1.3, per cent free fatty acids—0.9 (as oleic). The mixed fatty acids (excluding non-sap.) were analysed spectrophotometrically and were found to contain 50.56% of linoleic, 30.24% of oleic, and 19.2% of saturated acids. The results differ from that obtained by Pieraerts and de Winter (Ann. Mus. Colon. Marseille, 36, No. 6, 5, 1938) who obtained 45% of linoleic, 35% of oleic and 20% of saturated acids. The difference is probably due to the non-availability of spectrophotometric technique to those workers. The composition is similar to that of *Luffa Acutangula* and conforms to the normal trends of Cucurbitaceae in not containing any conjugated or non-conjugated triene acids. The possibility of the oil in industry, if available in commercial quantities has been indicated.

**249. The Composition of Indian Tobacco Seed Oils—II.**

S. R. CHAKRABORTY and M. M. CHAKRABORTY, Calcutta.

In continuation of our earlier communication to the Indian Science Congress (Proc. 41st Ind. Sc. Cong., Part II, Section IV, No. 37) the composition of 15 samples of Indian tobacco seed oils obtained from 5 specified regions of eastern, western, northern and southern India has been studied by modern Spectrophotometric techniques. It was possible to get authentic specimens of different varieties and species. It was found in general that the oil content varied from 36 to 42% in the case of *Nicotiana Tabacum* and 32 to 36% in the case of *Nicotiana rustica*. The iodine values varied from 129.7 to 140.2, the non-saponifiables from 0.7 to 2.2%. The content of linolenic acid varied from 1.1 to 2.0% and that of linoleic acid from 63.6 to 72.6% with consequential changes in the contents of oleic and saturated acids. The present series of investigations corroborate more the findings of *Riemenschneider* (as against *Hilditch's*) in that regional differences do not produce marked change in the composition of tobacco seed oils which is so noticeable in the cases of sunflower and safflower seed oils. It is also clear that varietal influences can operate effectively only when the environmental factors are favourable. It can be stated categorically from the results of the present analyses that the variation in composition of Indian tobacco seed oils is of comparatively minor nature and the consequences thereof do not preclude the use of this oil obtained from any region of India in paint and varnish industry by possessing generally over 66% of polyethenoid acids, a critical value propounded by *Hilditch*.

**250. The component acids of the Indian Sahjan fat.**

S. P. PATHAK and G. D. PANDE, Banaras.

Only few fats of the Moringaceae family have been studied so far. Ben seed from Haiti and Trinidad were studied by Jamieson and Dunn & *Hilditch*. The Indian Sahjan (*Moringa Pterygosperma*) seed fat analysis is not yet reported and

the study of this fat is done by the authors in this laboratory by the up-to-date methods of fractionation etc. The component fatty acids are, palmitic 9.8%, stearic 21.6%, arachidic 1.4%, behenic 1.6% and lignoceric 2.1% amongst the saturated acids and oleic acids only to the extent of 63.5% amongst the unsaturated acids. Linoleic acid could not be found.

It has been suggested that the Sahjan Oil can very well serve as a substitute for foreign Olive Oil, which is evident from the above composition.

## 251. The component acids of the Indian Crocodile fat.

S. P. PATHAK and G. D. PANDE, Banaras.

Crocodile (*Gavialis gangeticus*) fat obtained from the animal caught at Banaras is studied for its component fatty acids and glycerides. The component acids have been studied by the usual fractionation method and the glyceride structure also by the same method after crystallisation from acetone and ether, and the final glyceride composition computed from the fractions.

The chief component acids present are: myristic 4.2%, palmitic 25.8% and stearic 8.9% as well as a small quantity of lauric acid. Amongst the unsaturated acids,  $C_{11}$ ,  $C_{16}$ ,  $C_{18}$ ,  $C_{20}$  and  $C_{22}$  are present to the extent of 2.0, 12.7, 33.2, 8.9 and 1.6% having mean unsaturations as -2.0, -2.0, -3.0, -4.8 and -8.0 respectively. The component glycerides are (i) 7.5% fully saturated, (ii) 27.7% mono-unsaturated-di-saturated and (iii) 15.8% di-unsaturated-monosaturated.

The component acids and glycerides resemble those of the amphibian fat, particularly lizard, so far reported. In other words the fatty acids and glyceride structure of the crocodile fat appear to lie midway between the marine animals on the one hand and land animal fats on the other.

## 252. Comparative study of fats from mature (mother) and immature (embryo) shark (*Galeocерdo Tigrinus*) liver oils.

S. P. PATHAK AND P. N. SUWAL, Banaras.

Liver fats from the mother and embryo of a variety of shark (*Galeocерdo Tigrinus*) have been studied to understand the relationship between these fats and their metabolism.

The mixed fatty acids from each of them were resolved into groups of acids varying in unsaturation by the lithium salt acetone and/or lead salt alcohol methods. Each groups of acids were methylated separately and fractionated.

Both the fats are found to belong to the fourth group of Tsujimoto's classification of the Elasmobranch fish liver fats. The liver fat of the mother shark contains 43.3% of saturated acids (palmitic 25.2%, stearic 13.8%, myristic 3.0% and arachidic 1.3%) and 56.7% of unsaturated acids ( $C_{11}$  0.4%,  $C_{16}$  7.8%,  $C_{18}$  23.7%,  $C_{20}$  15.5% and  $C_{22}$  9.3%). The embryo liver fat contains 39.1% of saturated acids (palmitic 25.1%, stearic acid 5.1% and myristic 8.6%) and 60.9% of unsaturated acids ( $C_{14}$  6.2%,  $C_{16}$  19.1%,  $C_{18}$  38.2% and  $C_{20}$  4.0%).

The unsaturations of the acids are -2.0, -2.0, -3.9, -5.6 and 10.9 of  $C_{11}$ ,  $C_{16}$ ,  $C_{18}$ ,  $C_{20}$  and  $C_{22}$  unsaturated acids respectively in the mother shark liver fat and -2.0, -2.0, -2.1 and -4.4 of  $C_{11}$ ,  $C_{16}$ ,  $C_{18}$  and  $C_{20}$  unsaturated acids respectively in the embryo fat.

The contents of saturated acids in both the fats is remarkably high unlike the marine liver fats in which it is present on an average to the extent of 20%. Apart from this the absence of  $C_{22}$  unsaturated acids and lower content of  $C_{20}$  unsaturated acid as well as the lower degree of unsaturation amongst the unsaturated acids



in the embryo shark liver fat suggests a process of hydrogenation in the animal system. It may also be said that the more reactive unsaturated acids have been utilised by the growing embryo.

### 253. Component Fatty Acids of the Seed fat of *Pongamia Glabera* (Karanja).

S. P. PATHAK and L. M. DEY, Banaras.

In the present work the fatty acid composition of *Pongamia Glabera* Seed Oil has been studied. *Pongamia Glabera* commonly known as 'Karanja', on extraction with acetone yielded 39.4% of fixed oil having an I.V. of 79.7 and S.E. 298.9. The component acids were found out by first hydrolysing the oil and then separating the recovered fatty acids into 'Solid' and 'Liquid' acids by crystallising their lead salts with alcohol. Each group was then converted into their methyl esters which were fractionated under high vacuum using an electrically heated and packed column. Saponification equivalents and Iodine Values of each of the fractions were determined and thereby the fatty acid composition of the fat calculated which is as follows: Palmitic—7.12%, Stearic—9.05%, Arachidic—2.00%, Behenic—4.48%, Lignoceric—1.54%, Palmitoleic—0.71%, Oleic—47.31%, Linoleic—18.63%, Gadoleic—8.86%,  $C_{22}$  (-2H)—0.17%, and  $C_{24}$  (-2H)—0.13%. The absence of Linolenic acid in the present case seems to be due to the effect of climate upon the composition of fats.

### 254. The Component Acids and Glycerides of *Areca catechu* fat.

S. P. PATHAK and S. S. MATHUR, Banaras.

In the present work the fatty acid composition of arecanut fat was determined by the usual fractionation method. The glyceride structure was studied by crystallisation of the neutral fat from acetone and ether; the composition of each of these glyceride fractions also was determined by the fractionation method and the final possible glyceride composition computed therefrom. The chief component acids are lauric (15.9%), myristic (46.2%), palmitic (12.7%), and in the unsaturated portion oleic (6.2%), linoleic (6.4%) as well as hexadecenoic acid (7.2%). Minor proportions of stearic, decanoic and of unsaturated monoethylenic  $C_{12}$  and  $C_{14}$  acids are also present. The chief component glycerides are (i) 56% of fully saturated (trimyristin, dimyristo and lauromyristo-palmitin); (ii) 30% mono-unsaturated-di-saturated (mainly hexadecenolauromyristin with some oleo-(linoleo-) myristo-palmitins and dimyristins); and (iii) 14% diunsaturated mono-saturated (oleo-linoleo glycerides, mostly oleo-linoleo-palmitin).

The glyceride composition follows the Hilditch's rule of widest or even distribution of acyl radicals in the glyceride molecule closely. The fully saturated glyceride content of the fat, determined separately by the method of Hilditch and Lea is 53.7%. The fully saturated components are found to contain 19.4% lauric, 54.6% myristic, 19.9% palmitic and 6.8% stearic acid. The proportions of various acids in it are similar to the corresponding ones in the saturated acid portion of the whole fat.

### 255. Canning of Fish (Rohu, *Labeo Rohita*).

A. N. BOSE, Jadavpur, Calcutta.

A method of canning of fillets of fresh-water fish Rohu (*Labeo Rohita*) has been suggested. The difficulties in canning of Rohu fish arises from the soft texture of the tissue which does not stand normal processing conditions and from

the objectionable flavour of the untreated fish, when canned. Texture of the tissue may be hardened by treatment with brine. Treatment with 21.2% NaCl brine for 2 hours at 25-30°C gave the best results as regards improvement of texture. The sources of objectionable flavour in the canned fish were found to be in skin and dark-meat, which should be removed before pre-cooking proceeding thermal processing. Some objectionable flavour is also contributed by white meat. This can be best removed by treatment of the brine-treated fillets, free from skin and dark-meat, with steam at 5 p.s.i.g. pressure for 30 minutes. The fillets after treatment with brine and steam as stated above, can be processed at 250°F. The product will have good texture and flavour except for mild green pea-flavour. The green-pea flavour is removed or masked when the fillets are canned with winter-processed cotton-seed oil.

#### 256. Solvent Extraction of Cotton Seed Oil.

N. K. ROY CHAUDHURY and S. K. NANDI, Kharagpur.

Solvent Extraction of cotton seed oil has been studied with five solvents. Both whole and delinted seeds were extracted for 3, 6 and 12 hours in a Soxhlet extraction apparatus. Analysis of the seeds gave—Moisture—9, Lint—8.3, Hull—40.0, Kernal—42.7 and oil content—16.5% by weight on moisture free basis.

Percentage oil extracted from whole seeds in 3 to 12 hours with different solvents were :—Benzene—80.99.9%, Ethyl alcohol—60.5—82.8%, Petrol (60-100°C)—55.92.6%, Solvent Oil (60-100°C)—49.61.5%, Hexane—58.7-77.5%. Much quicker extraction was obtained by using delinted seeds, when oil extracted in 6 hours was the same as that obtained from whole seeds in 12 hours. While maximum extraction of oil was obtained by Benzene, followed by petrol, alcohol, hexane and solvent oil; extraction of colour was in the following order—solvent oil, hexane, benzene, petrol and alcohol. Extraction of whole or delinted seeds did not make any difference in the colour of oil. Benzene has been found to be the best solvent for production of non-edible oil.

#### 257. Preparation of Activated Carbons from the waste materials of the Oil Industry viz. the Shell (Husks) of Neem, Castor and Mahua Seeds.

OM PRAKASH, T. R. SHARMA and AMANULLAH KHAN, Kanpur.

In this investigation Chemical activation method was adopted for the preparation of activated carbons, wherein several activating agents viz. CaO, ZnCl<sub>2</sub>, NaOH, CaCl<sub>2</sub>, Al<sub>2</sub>O<sub>3</sub>, H<sub>3</sub>PO<sub>4</sub> and alum were tried in the pre-digestion. Zinc Chloride was found to give the best results. The shells were first allowed to remain dipped in the aqueous solution of the activating agents for two hours. Different amounts of activators used were 150%, 100%, 50%, 35% and 20% on the weight of shells dissolved in 200 c.c. of water. The shells were then dried and carbonised at different temperatures for different length of time. The mass was then leached with dil. HCl, washed, dried and powdered. The active carbons were tested for their decolorisation properties with groundnut oil, caramel, methylene blue and iodine solutions. Apparent and bulk densities were also determined. It is found that neem shell impregnated with 35% ZnCl<sub>2</sub> and carbonised for 3 hours at 750-800°C gives the best carbon for bleaching of groundnut oil and with 50% ZnCl<sub>2</sub> (other conditions being the same) the carbon obtained has the maximum adsorptive powers for iodine and methylene blue. Mahua shell with 100% ZnCl<sub>2</sub> gave carbon which exhibited the maximum adsorption for caramel. The products compare favourably with Standard Carbon's e.g. Norit, I.C.I. etc. and Neem shell carbon is nearly twice as effective as Norit for iodine adsorption.



**258. A Study of the Forest Oilseeds : Albizzia labbek and Albizzia procera and their Oils. Part I.**

OM PRAKASH, T. R. SHARMA and AMANULLAH KHAN, Kanpur.

The seeds of the two forest seeds *Albizzia labbek* and *Albizzia procera* have been studied. Characteristics of the seeds, their oils and cakes have been determined. The two seeds and their oils and cakes have been found to be more or less similar in nature. The seed of *Albizzia labbek* and *Albizzia procera* (% shell—42.4 and 39.7; % kernel—57.6 and 60.3 respectively) yield on the average about 12.3% oil (on kernel) of semi-drying nature. Both the oils on the average show the presence of small amount of hydroxy acids—Acetyl value—12.8; Acid value 3.3; Saponification value—192.8; Iodine value (Wijs)—105; Hehner value—92.2%; Non-saponifiables—1.6% and about 29.5% of saturated fatty acids.

On examination of the Solvent extracted meal of *Albizzia labbek* and *Albizzia procera*, the average content of moisture, crude protein, carbohydrate, fibre and ash was found to be 8%, 25.6%, 48.9%, 12.5% and 4.4% respectively. Following values were obtained for the minerals: Phosphate—0.75%, Soda—0.45% and Potash—1.3%. Furfural was also estimated in the extracted meals and found to be present to the extent of 6.8% (*A. labbek*) and 7.2% (*A. procera*) respectively.

**259. Isomerisation of Linseed Oil.**

OM PRAKASH, ATMA RAM, V. D. ATHAWALE and S. C. PANDEY, Kanpur.

Isomerisation of Linseed Oil using anthraquinone as the catalyst forms the subject matter of this paper. Set of experiments were carried out for the reaction with varying percentages of the catalyst at different temperatures and for different lengths of time.

It has been possible to obtain isomerised linseed oil economically by heating the oil at 250°C for ½ hour in presence of 5% anthraquinone under inert atmosphere. The presence of conjugation is established by high refractive index, lower Iodine value, substantial Diene value and finally confirmed by spectrophotometric analysis. The isomerised oil obtained has beautiful greenish yellow appearance. The catalyst is recoverable completely, and the varnish made of oil shows better drying properties and give films with higher resistance to water, acid and alkali than raw linseed oil.

**260. Elaidination of Groundnut Oil.**

OM PRAKASH, ATMA RAM and S. C. PANDEY, Kanpur.

Elaidination of Ground nut oil under different conditions of reaction has been studied. Selenium in metallic form has been employed as the catalyst. The experiments have been carried out with different percentage of catalyst at different temperatures over a range of 180° to 250° C, and for different lengths of time extending from two to 6½ hours in an inert atmosphere of CO<sub>2</sub>. Products having melting points as high as 26.7°C have been obtained, having good appearances, colour and crystal structure. Optimum conditions of reaction have been found to be heating the oil with 1% catalyst for 6 hours at a temperature of 215°C.

**261. Essential oil of Eupatorium Odorum. Linn.**

S. N. DHINGRA, D. R. DHINGRA and G. N. GUPTA, Kanpur.

The essential oil of the plant of *Eupatorium odoratum*, a common hedge plant, has been examined. The oil was obtained by distilling with steam the cuttings

ide before and during the rainy season (i.e. April and July, 1954). The Physico-chemical constants of the two oils are as follows:—

- A. The oil obtained in April, 1954:— $d_{37}^{37}$  0.9228,  $n_D^{30}$  1.506,  $n_D$  -17.0, Acid value 1.56, Ester value 23.23, Ester value after acetylation 56.53, Aldehyde content (Sod. Bisulphite) 12%, Phenol content (Caustic soda absorption method) 10%, soluble in equal volumes of 95% alcohol.
- B. The oil obtained in July, 1954:— $d_{31}^{31}$  0.9061,  $n_D^{30}$  1.499,  $n_D$  +11.6, Acid value, 1.48, Ester value, 13.88, Ester value after acetylation, 46.71, Aldehyde content 5%, Phenol content 6%, Soluble in equal volumes of 95% alcohol.

## 62. Thio-urea complexes of Essential Oils.

S. N. DHINGRA, D. R. DHINGRA and G. N. GUPTA, Kanpur.

In 1940 Bengen discovered the property of urea to form complexes with certain organic compounds. In 1947, the idea was extended by Angla (Compt. rend. 224, 102, 1947) to Thiourea.

The present study was made with a view to determine how far this complex formation can be applied for the separation and analytical purposes in essential oils. A number (about fifty-five) of essential oils, isolates, and synthetic aromatics were treated with saturated aqueous solution of thiourea. The latter has been found better than those of ethyl or methyl alcoholic solutions. Out of these amphor oil, chamomila oil, guava leaves oil, eupatorium oil, ocimum oil, terpenyl acetates, linalyl acetate and safrol formed the complexes. Further work on their dissociation temperature etc. is in progress.

## 263. Utilization of Andaman Resin.

NRIPENDRA CHANDRA SAHA and A. N. SAHA

The physical and chemical properties of the resin from *Canarium Enphallum* have been studied.

Colour	...	...	...	Brownish yellow.
M. P.	...	...	...	130°C.
Sp. Gr.	...	...	...	1.0 at 30°C.
Essential oil content	...	...	...	2.3%
Acid value	...	...	...	25.0
Sap value	...	...	...	25.5
Iodine value	...	...	...	55.9
Colour reactions	...	...	...	Halphené Hicks—Light violet Storch—Deep red.
Heat Reactivity	...	...	...	Non-reactive.

The oil varnish producing as well as lacquer producing properties have been examined. Physical and chemical properties of essential oil obtained were studied.

## 264. Synthesis of Saturated Carboxylic Acids at high Pressures.

S. K. BHATTACHARYYA, Kharagpur.

Extensive and intensive investigations have been carried out on the synthesis of acetic acid and propionic acid by the reactions of carbon monoxide with methyl alcohol and ethyl alcohol respectively in the vapour phase at a pressure, 50 atm. to 400 atm., and a temperature, 150-250°C. Various catalyst compositions contain-



ing Ni, Co, and Fe have been used. Both the reactions have been found to have identical characteristics, which may be summarised as follows:

(i) As catalysts, the halides of the above metals are found to be superior to the reduced metals, the catalytic activity being in the order: iodide > bromide > chloride. The activity of the metals is in the order: Ni > Co > Fe.

(ii) As a catalyst support, silica gel is superior to kieselguhr, pumice or kaolin.

(iii) The optimum conditions for the synthesis of acetic acid using nickel, cobalt and iron catalysts in the form of iodides deposited on silica gel are: (a) a catalyst composition, metal: silica = 50: 50; (b) a temperature of 180°C; (c) a pressure of about 260 atms.; (d) methanol containing 5% water; and a residence period of about 2 hours. Using 84.2% nickel iodide on silica gel (Ni: SiO<sub>2</sub> = 50: 50) as the catalyst, a total conversion of 59.2% of methanol has been obtained in a period of 2 hours under the optimum conditions of which free acetic acid corresponds to 45.9%, methyl acetate 3.7% and gaseous decomposition products 9.6%.

For the synthesis of propionic acid using nickel, cobalt, or iron iodide deposited on silica gel as the catalyst, the optimum conditions for the best yields are: (a) a catalyst composition: metal: SiO<sub>2</sub> = 50: 50; (b) a temperature of 230°C; (c) a pressure of 320 atms.; (d) ethyl alcohol containing 50% water; and (e) residence period of two hours.

Using 84.2% NiI<sub>2</sub> on silica gel as the catalyst, a total conversion of 69.8% ethanol has been obtained in a period of 2 hours under the above optimum conditions, of which free propionic acid corresponds to 37.5%, ethyl propionate 11.4% and gaseous decomposition products, 20.9%.

Decomposition studies of carbon monoxide, methyl alcohol, ethyl alcohol, acetic acid and propionic acid in presence of NiI<sub>2</sub>-SiO<sub>2</sub> gel catalyst have been made at different temperatures and pressures with a view to elucidating the course of reactions leading to the formation of various gaseous products during the synthesis of acetic acid and propionic acid.

It is extremely interesting to note that all these catalysts exhibit maximum catalytic activity only in the first experiments, and it decreases considerably in the second and subsequent experiments. The 'spent' catalysts can, however, be completely reactivated either by the addition of minute quantities of cold water on the spent catalyst surface or by releasing the reaction products at sufficiently low temperatures, 60-80°C.

## 265. The Indian Otto of Rose.

G. N. GUPTA, GANESH CHANDRA and D. R. DHINGRA, Kanpur.

Rose otto has been manufactured in India since the beginning of the 17th century, but no systematic work seems to have been done on the scientific line either in the manufacture or its examination. No analytical data are available in the literature about them.

Samples of rose ottos were prepared using Rosa Damascena, Rose Teplitz and Rose Edward flowers. The percentage yields obtained by distilling the above Rose flowers, and their physico-chemical properties have been determined.

## 266. Purification of Technical Monoglycerides.

S. SARKAR, R. C. BASU ROY CHOUDHURY, D. GANGULY and M. N. GOSWAMI, Calcutta.

The monoglycerides prepared by usual technical methods such as direct esterification of fatty acids and glycerol or glycerolysis of fat and glycerol always contain substantial amounts of free glycerol, diglycerides and triglycerides. Free glycerol was washed out from the ether solution of the technical products by a saturated

tion of sodium sulphate. The di- and triglycerides were separated from the monoglyceride by the method of low temperature crystallisation. The solvent employed was methyl alcohol and two successive temperatures were used viz.  $5^{\circ}\text{C}$  and  $-45^{\circ}\text{C}$ . In this way a monoglyceride having a concentration of 54% monoglyceride content could be concentrated to a product having a concentration 80-85% monoglyceride.

## 7. Investigations on Reclamation of Rancid Food Fats.

D. GANGULY, R. BASU ROY CHOUDHURY and M. N. GOSWAMI, Calcutta.

So far the problem of reclaiming rancid edible fats has received little attention on the part of the scientists and practically no serious attempt has been made to study this aspect of fat technology. The present investigators applied different methods of refining so as to reclaim and recondition rancid butter fat by removing undesirable puriferous compounds and to make it suitable for human consumption again. By applying the methods mentioned below it has been possible to improve rancid fat to a large extent. The methods employed were:—

(1) Steam Refining, (2) Adsorption Refining, and (3) Chemical Refining.

## 8. Utilization of Neem Oil.

B. GHOSH and S. P. DAS, Jadavpur, Calcutta.

Neem oil is nonedible, bitter, foul smelling. However, the quantity of neem oil available calls for its proper utilisation in the industry. This oil may replace various edible oils in different industries, e.g., the soap and the candle industry. As India is short of edible oils, the possibility of such replacement is worth looking into.

Refining of crude neem oil was studied, the refining agents used being alkali and alcohol. Commercially available samples of neem oil were found to contain 5 to 15 per cent free fatty acids (expressed as oleic acid). The loss during alkali refining was high because a considerable amount of neutral oil was lost in the foots. The alkali refined oil was less dark in colour than the crude oil though it was still very bitter. Refining of neem oil with alcohol and other solvents has been studied for the past thirty years. Alcohol can extract the bitter constituents from neem oil completely. However, the process is not likely to be economical unless the neem oil is available at a price substantially lower than that of other oils. A design method for the alcohol extraction process has been presented in the paper. The method is analogous to the design of deodourisers, calculations being based upon the extraction of free fatty acids rather than the bitters.

Neem oil is suitable for the production of soap. When grained several times the neem oil soap contains much less bitters and odourous compounds than ungrained soap, and can be blended with other oils for the manufacture of laundry soaps, though the use of neem oil in toilet soap production will be restricted because of its bitterness and offensive odour.

The bitter constituents of neem oil were tested for their bacterostatic and antiseptic properties. It was observed that neem oil bitters had practically no such property *in vitro*. Reports of excellent results in the treatment of certain types of skin infection by the application of preparations from neem oil bitters should be substantiated by further clinical investigation, and the efficacy of these preparations should be compared with other similar preparations available in the market before anything definite can be said about the future of the medicinal preparations from neem oil bitters. It appears that no such investigation has yet been undertaken.



Neem oil bitters can be completely removed by adsorption. The oil being viscous it was diluted with a suitable solvent like benzene and then passed through the adsorption column. One volume of oil diluted with four of solvent was found to be suitable. Activated alumina, fullers earth and patented adsorbent like "Tonsil" were found capable of removing both colour and bitterness of the oil. The refined oil obtained by the removal of the solvent was tasteless and colourless and could be easily deodourised. The amount of oil that could be freed from bitterness by adsorption was found to be about five times the weight of adsorbent in the column for the activated alumina and "tonsil", and somewhat less for the fullers earth used.

It is difficult to estimate the amount of neem oil potentially available. According to one estimate the amount of oil available per annum is of the order 150,000 tons. The amount of oil used in the Indian soap industry is about 50,000 tons per annum. It is evident that properly refined and deodourised neem oil will not only supply a considerable fraction of the demand of soap industry but also will be available for other industrial purposes.

## 269. Catalytic Vapour Phase Oxidation of Ortho Xylene. Part II.

I. B. GULATI and S. K. BHATTACHARYA, Kharagpur.

In continuation of our work on the catalytic vapour phase oxidation of xylene (Proc. Ind. Sci. Cong. Part III, 1954) the oxidation of ortho xylene was further studied using promoted fused vanadium pentoxide catalysts under different experimental conditions. Investigations were also carried out using oxygen as the oxidising agent in place of air. With oxygen it was possible to maintain near the same percentage conversion at quite low oxygen xylene ratios. Thus the space time yield rose quite high at constant space velocity. It was found that at a space velocity of 5480 and a temperature of 470°C, when the molar oxygen xylene ratio is decreased from 279 to 87 the space time yield of phthalic anhydride from unpromoted fused vanadium pentoxide catalyst increased from 54.6 to 189.3 (gm./hr./litre of catalyst) though the percentage conversion changed only from 47.78 to 51.87%. The same effect was observed even at lower space velocities.

Material balance studies for different catalysts show that though the fused vanadium pentoxide catalyst gives much higher conversion to phthalic anhydride it gives quite low conversion to carbon dioxide as compared with the kieselguhr supported unfused vanadium pentoxide catalyst. The amount of carbon dioxide formed increases slightly when oxygen is employed as the oxidizing agent.

## 270. Extractives of South Arcot Lignites.

D. VENKATESWARLU, N. K. ROY CHAUDHURY and S. V. L. N. RAO, Kharagpur.

Monton wax is a product of industrial importance. It is used in the manufacture of lubricants, polishes, candles etc. This wax can be obtained as an extractive from certain types of lignites of South Arcot District.

A systematic study of the physical, chemical and petrographical characters of the lignites was made to investigate the relationship between the extractive yield and the constitution of lignites. It is observed that the softer varieties of lignites and those which are more volatile in nature yield greater quantities of wax. The maceration and petrographic studies indicate that the presence of attrition is in general related to the quantity of the extractive yields.

From this study, it is concluded that the examination of physical, chemical, maceration and petrographical characters of South Arcot lignites is useful in the preliminary selection for obtaining higher yields of extractives for industrial production and utilisation.

**271. Essential Oil of Ajowan seeds and herb.**

J. N. TANDON and G. N. GUPTA, Kanpur.

As no data on the chemical composition and Physico-chemical properties of the oils from Indian Ajowan seeds and herb are available in the literature, therefore, the above oils were made and examined.

It has been found that the specific gravity of oils from Ajowan seeds is higher than those given in the literature. Other properties lie, however, within the prescribed limits. The oil has been found to contain p-Cymene, Gamma-Terpinene, Dipentene, thymol and Carvacrol. In the case of herb oil, the % of thymol was found to be very low i.e. 24% approximately. It also requires much higher quantities of 30% alcohol for its solubility. The extraction of thymol from herb oil is therefore not economical.

**272. Dill seeds and herb oils.**

G. N. GUPTA, GANESH CHANDRA and S. T. H. ZAIDI, Kanpur.

Anethum Sowa Roxb. commonly known as dill is grown in large quantities in India. The essential oil from the seeds and herb were prepared and examined. The essential oil from the seeds contained 41.7% carvone, 23.24% terpenes mainly limonene and 19.20% dillapiol. The herb oil contained much less quantity of carvone (13.5%) and also 45% d- $\alpha$  Phellandrene but no limonene. The physico-chemical constants of these oils have been studied.

**273. On the chemical composition of the Mucilage from the seeds of Ocimum sanctum, Linn. (Tulsi).**

G. B. NADKARNI and V. A. PATWARDHAN, Sangli.

Mucilage from the non-fatty matter obtained from the seeds of the plants of *Ocimum sanctum*, Linn. (Tulsi), grown on the premises of the Willingdon College, was extracted with a 2% solution of sodium hydroxide and was precipitated as a pale white creamy substance by means of acidified ethanol. The mucilage was hydrolysed by boiling with 5% sulphuric acid solution and was separated into a barium salt of uronic acid and a syrup containing reducing sugars (40%). On analysis of the syrup by circular paper chromatography, it was found to contain xylose and glucose, the percentages of which were determined to be 26 and 14 respectively. The uronic acid, of which the barium salt was obtained, was identified to be glucuronic acid. The molecular proportion of glucuronic acid, xylose and glucose in the mucilage, was found to be 2:3:1.

**274. Fatty Oil and Non-Fatty matter from the Seeds of Thespesia populnea, Linn.**

V. G. SONAR and V. A. PATWARDHAN, Sangli.

The brown coloured and ellipsoid, fairly big seeds of *Thespesia populnea*, (average weight of a seed 0.129 gram), obtained from the tree on the Willingdon College premises, yielded on extraction with ether, 18.2% of a somewhat thick, deep red coloured non-drying oil. The oil gave the following constants: Sp. gr. at 34°C. 0.9333; Refractive Index at 27.5°C. (Abbe') 1.4884; Acid V. 17.47; Sap. V. 226.8; Iodine V. (Wijs) 93.5; Acetyl V. 31.8; R.M.V. 2.47; Polenske V. 0.41; Helmer V. 93.09; Unsaponifiable matter (sterols 22.7%) 1.08%.

The mixed fatty acids contained 25.9% solid acids and 74.1% liquid acids. The percentage composition of the mixed fatty acids is as follows:—Myristic acid 4.9,



Palmitic acid 18.7, Stearic acid 2.3;  $\alpha$ -Linoleic acid 13.5; Isomeric Linoleic acid 14.2 and Oleic acid 46.4.

The non-fatty matter gave the following results on analysis (A.O.A.C.): Moisture 7.6%; ash 4.0%; Crude Protein 15.6%; Crude Fibre 30.5%; and Digestible Carbohydrates 42.3%. The percentage of sugars and starch was found to be 0.22 and 18.52 respectively. Analysis of the ash showed the presence of iron, calcium, potassium, phosphate and carbonate, chloride and silica being present in much smaller proportion.

By means of circular paper chromatography for the identification of amino-acids obtained from the non-fatty matter, the presence of the following amino-acids has been noted: Leucine, Alanine, Arginine, Glutamic acid, Histidine, Serine, Valine, Phenylalanine, Tryptophan and Tyrosine.

#### **275. Preparation of Castor-modified Alkyds by "the Drying Alkyds Castor Process": Part I.**

N. BHOJRAJ NAIDU and S. A. SALETORE, Hyderabad-Deccan.

The aim of the present work on the preparation of oil-modified alkyds used in the protective coating industry, is not only to find out new raw materials, but also to effect improvement in the processing techniques from the laboratory to the pilot plant scale. In the present study, therefore, castor-modified resin was prepared with a short oil group (40 percent oil length) using phthalic anhydride and glycerol. The kinetics of the esterification procedure and the suitability of the resin as a medium for paints, have been also studied. The castor resin cooked at 238-39°C. for about 2 hours was 'cut' to 66 per cent solids in xylol, which gave a viscosity of 148 poises at 25°C. The resin was soluble in benzene and butanol and had an acid value of 7.4 by the Pyridine method. The drying time was found to be too slow with the alkyd resin reduced to a viscosity at 25°C. of 2 poises containing 0.05 per cent cobalt based on the alkyds. Owing to its non-drying character and pale yellow colour with high gloss, suitability as a plasticizer for nitro cellulose lacquers and other resins is suggested. Its low acidity also permits the use of zinc oxide and other reactive pigments in paints.

#### **276. Studies on Karanja Oil: Spectrophotometric Investigation of the Unsaponifiable Matter.**

S. K. K. JATKAR and B. N. MATTOO, Poona.

Ultraviolet absorption, and fluorescence spectra in the visible region excited by hydrogen discharge, of Karanjin, Pongamol and the new compound, m.p. 188°, have been studied. Probable skeleton structures for the latter two compounds have been suggested, on the basis of their absorbing and fluorescing properties.

These compounds have been estimated directly in Karanja oil spectrophotometrically. Choosing a proper wavelength region and a proper concentration range, the interfering effects due to other constituents (lipids, sterols and commonly occurring coloring matter) were overcome, and the maximum possible content of these unsaponifiables is estimated at: Karanjin, 2.6%; Pongamol, 1.6%; and the compound m.p. 188°, 0.4% on weight of oil.

These results are on the assumption that no other substance similar to these constitutes any significant portion of the unsaponifiables. To check the validity of the assumption, chromatographic study of the unsaponifiables of the oil has been undertaken and the work is in progress.

**277. Utilisation of Agricultural Waste.**

D. S. BENDALE and S. K. K. JATKAR, Poona.

Agricultural wastes such as bagasse, rice-straw, ground-nut hulls, etc., have been studied for the production of chemical cellulose by partial hydrolysis with nitric, sulphuric and hydrochloric acid followed by alkaline delignification and estimation of the reducing sugars and cellulose.

Lignins from bagasse, rice-straw, and ground-nut hulls etc. were isolated by Payne's method. Determination of equivalents of the above preparations was carried out by electrometric titrations. The molecular weights calculated from these results vary for different lignin preparations, indicating different degrees of polymerization. These findings support the structural formula of lignin as given in literature.

**278. Preparation of activated carbon from Kans (*Saccharum Spontaneum*).**

B. BISWAS, G. N. GUPTA and V. N. NIGAM, Kanpur.

Kans, a persistent weed is a source of great annoyance to the cultivators as it often encroaches the fields and is difficult to eradicate. In order to produce a large quantity of food crop, it is imperative that more land must be reclaimed, and disposal of kans is thus becoming a problem. Since various cellulosic materials like bamboo, rice husk, ground-nut husk, coconut shell etc. have been found by different workers as a suitable material for the preparation of activated charcoal, it was thought desirable to examine its suitability for activated charcoal using various activating agents like ammonium carbonate, caustic soda, zinc chloride, lime and calcium chloride. The percentage of activating agent used varied from 5-20% on the weight of the sun dried kans. The temperature of activation varied from  $850^{\circ} \pm 10^{\circ}\text{C}$ .

It has been found that the samples prepared by the use of zinc chloride as an activating agent are better so far as absorptive properties are concerned, than those prepared by other activating agents.

**279. On the Effect of Bleaching of Arachis Oil.**

M. L. SEN GUPTA and U. P. Basu, Calcutta.

Arachis oil is used for various purposes in industry but for this the crude oil needs bleaching. Depending on the nature of the bleaching earth used, the process would alter the character of the oil to different degrees so far as its acid value, tocopherol content, peroxide value and its fatty acid structure are concerned. Some would be found to remove the colouring matter without any appreciable effect on the above characteristics, whereas there is another group of bleaching earth that would exert an influence on the character of the oil.

Work in the above direction tends to show that the fuller's earth (natural or activated) falls under the former group. Bentonites and "Tonsil" clay induce the formation of triene conjugation but do not appreciably remove the tocopherols the presence of which is helpful in retarding the increase in peroxide values. The paper describes the effect of bleaching two grades of commercial oil by different bleaching earths.

**280. Vitaminisation of hydrogenated groundnut oil (*Vanaspati*).**

B. B. ROY, Calcutta.

Vanaspati in India nowadays requires to be enriched with synthetic vitamin A. Stability of synthetic and crystalline vitamin A acetate used for enriching vanaspati



was studied previously (Roy, *Jour. Sci. Ind. Res.* 13B, 496, 1954). Almost all the manufacturers of vanaspati in India use an imported product, 'vanitin', of Hoffmann La Roche, Basle, Switzerland as the source of vitamin A. The present paper concerns the study of the stability during storage and heating of synthetic vitamin A acetate of 'vanitin' used in hydrogenated groundnut oil (m.p. 37°C). The rate of destruction of vitamin A is the highest during the first fortnight, after which the rate gradually falls off. After 3 months the value is reduced to 1/2 to 1/5 of the original value according to the amount of vitamin A originally present. The dissolved oxygen in hydrogenated groundnut oil may presumably be responsible for the initial loss; blowing of molten oil by nitrogen or carbon dioxide may perhaps remove this difficulty. Ethyl gallate affords no material protection to vitamin A, specially at lower concentrations of vitamin A, perhaps because 'vanitin' already contains some antioxidants. Losses of vitamin A by heating the enriched hydrogenated groundnut oil are not great, as expected, at the lower temperature (110°C) studied, but losses of the order of 50-100% may occur at the higher temperature of 250°C. Ethyl gallate affords in some cases a small amount of protection. Previously (*loc. cit*) it was found that ethyl gallate gives vitamin A acetate (crystalline) in hydrogenated groundnut oil small but significant protection during storage and a good protection during heating and cooking, though the protection is not as great as that in regard to peroxide formation. In the case of 'vanitin' protection afforded by ethyl gallate is even smaller than in the former, and hardly significant, while the effect on the inhibition of peroxide formation is still marked. It is possible that the inability of ethyl gallate to afford significant protection to vitamin A of 'vanitin' is due to the fact that it already contains the antioxidants,  $\alpha$ -tocopherol and lecithin. On the whole it would seem that addition of ethyl gallate to 'vanitin'-enriched vanaspati would not appreciably improve matters.

## 281. Comparison of blended and straight-hardened hydrogenated groundnut oils (Vanaspati) regarding their keeping quality.

B. B. ROY, Calcutta.

The present investigation concerns the study of the relative stability of blended and straight-hardened hydrogenated groundnut oils, all melting at 37°C. Among the blended oils, the ones having greater proportions of refined groundnut oil show higher rate of formation of peroxides and acidity. The straight-hardened oil appears to be much more stable (indicated by both peroxide and acid values) than even that blended one, having the least amount of refined oil, prepared out of a hydrogenated sample of m.p. 40°C which is close to that of the straight-hardened sample. Apart from the known effects of presence or absence of antioxidants or pro-oxidants, and of the different melting points, iodine values and initial peroxide and acid values on the stability of fats and oils, linolenin and linolein contents are also recognised to influence the keeping quality. Since no linolenin is present in the present case, the presence of linolein is probably of importance. Actually, it is found that the stability of the blended and straight-hardened samples may be correlated, among other factors, with the least proportion of linolein in the straight-hardened sample and higher proportions of linolein in the blended samples. The different degrees of stability of different samples of blended samples also seem to have some correlation with their linolein contents. The proportionality is, as expected, not strict as other factors affecting stability are also involved. It is also noted that the straight-hardened oil is the stablest inspite of its high oleic acid content, which is the highest among all samples. This would indicate that oleic acid does not influence stability so long as linoleic acid is present. Among the blended and straight-hardened hydrogenated oils, the former will usually have greater amounts of linolein, and hence this factor, apart from others, will affect their stability

adversely. In view of the fact that a highly hardened fat can be blended with a large amount of liquid oil to form a consistency of the straight-hardened one, determination of linoleic acid content and to a less extent of iodine value would help to differentiate the blended from the straight-hardened vanaspati. It may be noted, however, that while the blended vanaspati would be less stable than the straight-hardened product, it would contain more of the essential fatty acid, linoleic acid. Increase of acid value is usually small. Though acid value has no direct relation with peroxidation, the rate of increase of acid value assumes a rough proportionality with that of peroxide value. The antioxidant suppresses the increase of acidity slightly but the increase of peroxide value greatly.

## 282. Study of Oil Gas Tar.

B. THAKUR, Patna.

Oil gas for Science laboratories is obtained by cracking Kerosene oil in the Mansfield Intensive type of plants. Tar is a bye-product of this process. The tar was distilled till the temperature reached 350°C. The distillate was collected in fractions of 25°C range. The analysis of the liquid fractions indicated that they are highly unsaturated and aromatic. They have very bad smell due to the presence of mercaptans. The lighter fraction is an excellent solvent for rubber, oils and bitumen. The distillate could be used in the preparation of lampblack. The pitch when intimately mixed with Calcium Carbonate can be used as a substitute for sealing wax and when reinforced with saw dust, asbestos or cotton waste could be used as a cheap thermoplastics. Black paints and varnishes could be prepared from the pitch, using a fraction of the oil of the distillate range 150-200°C as a vehicle and distillate of the range up to 150°C as a thinner. This paint could be used as an excellent protective coating for iron articles.

## 283. Non-fatty Matter from the Seeds of (i) *Ocimum basilicum*, Linn., and (ii) *Ocimum canum*, Sims.

M. A. SHAIKH, P. S. JAVADEKAR and V. A. PATWARDHAN, Sangli.

The non-fatty matter in the seeds was obtained after complete extraction of the fatty matter from the crushed seeds by means of ether. On analysis of the non-fatty matter obtained from the seeds of *Ocimum basilicum*, Linn. (Sabja), by A.O.A.C. methods, the following percentage composition was obtained : Moisture 10.3, Mineral matter (ash) 7.15, crude protein 19.6, crude fibre 35.0 and digestible carbohydrates 27.95; (starch 12.33% and sugars 1.67%). Ash contained iron, calcium, magnesium, potassium, carbonate, phosphate and silicate. The ethyl acetate extract of the non-fatty matter showed the presence of saponins.

The identification of amino-acids has been done by the application of circular paper chromatography. The chromatogram obtained has shown the presence of leucine, phenylalanine, valine, alanine, glutamic acid, serine, arginine and histidine.

Non-fatty matter from the seeds of *Ocimum canum*, Sims. gave the following percentage composition : Moisture 12.4, mineral matter (ash) 6.35, crude protein 11.9, crude fibre 43.65, and digestible carbohydrates 25.7; (starch 14.17% and sugars 0.12% only). Qualitative analysis of the ash showed the presence of iron, potassium, sulphate, carbonate, phosphate and silicate. Ethyl acetate extract of the non-fatty matter showed the presence of saponins.

The chromatogram showed the presence of the following amino-acids : Leucine, phenylalanine, valine, tryptophan, tyrosine, alanine, glutamic acid, serine, arginine and histidine. The faint character of the corresponding bands showed that phenylalanine, tryptophan and tyrosine were present in much smaller proportion.



**284. Inhibition of Corrosion of Steel by Pigments.**

A. K. CHAUDHURY and S. C. SHOME, Calcutta.

The inhibitive action of lead pigments on the under-water corrosion of steel is investigated by the potential measurements. Litharge, red lead and mixtures of red lead and litharge in varying proportions are used as pigments. Experiments are carried out to study: (1) the passivating action of pigment suspended in water (no oil being used), the steel specimen remaining covered by the aqueous extract of the pigment; (2) the inhibitive action of oil-paint on the corrosion of steel placed in water contained in a beaker, the paint being applied on the inside wall of the beaker; and (3) the protection conferred by oil-paint under water, the paint being applied on the steel specimen.

The results suggest a correlation between the basic character of the pigments and their inhibitive action on the corrosion of steel. In certain cases, however, the products of interaction of red lead and linseed oil may produce the passivating effect.

**285. A modified Buchner Filtering Flask.**

H. G. BISWAS, Calcutta.

A metallic flask has been designed and made for semi-large scale and continuous operation. The flask is provided with a sight-glass at the top of which is a valve for the inlet of air and a stop cock at the base of the flask. It ensures practically continuous working as the funnel attached to the flask is not to be detached when taking out the filtrate as in the ordinary glass Buchner flask. The funnel is placed as usual, the side tube is attached to the water pump or vacuum pump, hot liquid to be filtered is poured into the funnel and when sufficient filtrate has accumulated it is drawn out through the stop cock by opening it without detaching the funnel from the flask. The material of the flask is to be chosen according to the nature of the solvent used in the operation. This flask has proved of great help in the semi-large scale preparation of organic compounds.

**286. A Modified Laboratory set up for Alkyd Preparation.**

N. BHOJRAJ NAIDU and S. A. SALETORRE, Hyderabad-Deccan.

This paper discusses certain essential factors influencing the laboratory design for the preparation of alkyds used so widely in the protective coating industry. In the light of experience gained some new modifications introduced into the apparatus by eliminating for reasons of constructional difficulties the thermometer well etc., which was formerly modified to include in the reaction vessel, have been fully described. In the present modified set up adequate arrangements for the flow of inert gas into the reaction kettle via sampling flask and a bent tube sealed into a solvent percolator tube, not open at the end but perforations made all round at about one inch below it, baffles for phthalic anhydride and traps for solvent and water of reaction condensation and a convenient size flask for drawing of samples by a vacuum device, have been fully given.

**287. Studies in Chrome Tanning—Part I: Complexing properties of certain salts of Inorganic Acids.**

Y. NAYUDAMMA and R. SELVARANGAN

Numerous researches have been made with regard to the penetrating power of a number of anions in basic chrome sulphate solutions, but these researches are mainly devoted to the salts of weak acids except for a few salts of strong acids like sod. sulphate, sod. chloride and sod. sulphite.

Studies have been made on the effect of the addition of calgon (sod. metaphosphate), sod. silico fluoride, pot. fluoride and pot. oxalate to basic chrome sulphate solution. The precipitation points and the changes in the pH in ageing were noted. Potentiometric and ion exchange studies were conducted on these liquors and the results compared. Calgon appears to be a promising salt to be added to chrome liquors for use in chrome tanning.

## 288. Attempts for the Manufacture of Ultramarine blue.

M. H. DESAI and TARALACHAN SINGH.

When Ultramarine blue made in the foreign countries was not available in India during the latter part of World War II, the authors tried to manufacture ultramarine blue in India and they were partially successful to get a quality which was marketable in absence of a better product due to war conditions. The unwashed quality of the Ultramarine manufactured was bright and shining and had the violet shade like the foreign product, but when washed and prepared the sample for the market, the lustre was not so attractive. Many attempts were made to obtain a shining product after washing but upto now the attempts are not successful.

The formula which was most successful has been given and the properties of the sample manufactured are compared with the best quality of a foreign product which was violet in colour and rich in silica and sulphur.

The comparison of the colour by the Lovibond tintometer, decomposition of Ultramarine by dilute HCl, results of oil absorption of the foreign product and the sample manufactured, are given.

The cost of production at that time was such that it was profitable to manufacture ultramarine blue. The foreign made ultramarine blue was available with difficulty at Rs. 3/- per lb. at that time. After the war was over, the price of English ultramarine blue came down and hence the interest in the manufacture was lost as the margin of profit was not sufficiently attractive.

## 289. Electrodeposition of Nickel and Zinc from the Sulphamate bath.

S. SATYANARAYANA, T. L. RAMA CHAR and K. R. KRISHNASWAMI,  
Bangalore.

Nickel and zinc have been successfully electrodeposited from the sulphamate solutions and the measurements made of the variables such as current efficiency, electrode polarisation, electrical conductivity etc. The results show that the sulphamate bath compares favourably with the sulphate solutions used for electroplating nickel and zinc.

## 290. Battery grade $MnO_2$ from M.P. manganese ore by Chemical treatment.

P. S. MENE, P. N. VISHEN, V. R. SOHONI and Y. G. SATHE, Nagpur.

Naturally occurring manganese ore of M.P. is not suitable for use as depolariser in dry batteries. Its compactness and impurities make it unsuitable. The ore is heated with charcoal to reduce manganese to the ous state and then extracted with nitric acid. Solution of  $Mn(NO_3)_2$  obtained is concentrated and subsequently decomposed to give  $MnO_2$  which is found to be suitable for dry batteries. Oxides of nitrogen evolved during decomposition can be absorbed in water and the resulting nitric acid recycled after concentration. The effect of time and temperature of reduction has been studied. Effect of variables such as concentration of acid, time of digestion and quantity of acid for maximum extraction is indicated. Results obtained conform with those of Nossen where natural gas was used for reduction.



## 291. Studies on Fischer-Tropsch Synthesis: Part V. Effects of Different Iron Catalysts at Atmospheric Pressure.

G. C. BASAK and N. C. NIYOGI, Howrah.

The work described in this paper relates to the development of suitable iron catalysts which would be effective at atmospheric pressure for hydrogenating carbon monoxide. Iron catalysts are found to be generally effective for this purpose at medium pressure only giving very low conversion at atmospheric pressure.

A number of iron catalysts with different promoters and accelerators by substitution of copper and calcium oxide by equivalent amounts of other metals and metallic oxides as also by varying the proportion of kieselguhr in the standard iron catalyst of composition 100 Fe : 5 Cu : 10 CaO : 30 kieselguhr, have been prepared. At the first stage five catalysts including the standard one have been prepared by the conventional method of precipitation by Sodium Carbonate solution of the solution of nitrates of metals at 100°C followed by the addition of kieselguhr and subsequent treatment with a solution of potassium hydroxide. The resulting paste of catalysts is finally granulated and dried at 110°C. The composition and bulk-densities of catalysts are as follows:—

1. 100 Fe : 5 Cu : 10 CaO : 30 Kieselguhr	...	...	0.795 kg/lit.
2. 100 Fe : 5 Cu : 10 CaO : 150 Kieselguhr	...	...	0.4805 kg/lit.
3. 100 Fe : 5 Cu : 7.14 MgO : 30 Kieselguhr	...	...	0.7168 kg/lit.
4. 100 Fe : 4.68 Co : 10 CaO : 30 Kieselguhr	...	...	0.812 kg/lit.
5. 100 Fe : 4.68 Co : 7.14 MgO : 30 Kieselguhr	...	...	0.8216 kg/lit.

Each catalyst after being pretreated for 50 hours with a mixture of gas 1 CO : 1 H<sub>2</sub> at 235°C at a space velocity of 4 litres per hour per 10 gm. of iron present in the catalyst, is used for synthesis reaction with a gas composition of 3 CO : 2H<sub>2</sub> with a little nitrogen at different temperatures ranging from 235°C to 280°C at the same space velocity.

From the results of analyses of the feed and exit gases resulting from the synthesis with each catalyst at temperatures ranging from 235°C to 280°C, the activity of the catalysts in relation to the contraction produced and efficiencies towards the formation of CO<sub>2</sub>, CH<sub>4</sub> and higher hydrocarbons other than CH<sub>4</sub>, are calculated. The percentage of liquifiable hydrocarbons in relation to the total products formed as also their yields in gms/CuM. of synthesis gas are also given.

It is observed that all the five catalysts show comparatively high overall efficiency and yield of C<sub>2</sub> and higher hydrocarbons at temperatures ranging between 255°C to 280°C even though the formation of CO<sub>2</sub> increases with rise of temperatures. It is also observed that the substitution of copper with cobalt greatly improves on the activity of the catalyst within the same temperature range. It is also found that catalysts impregnated with MgO behave better than those with CaO.

## 292. On Desulphurisation of Alloys in Hydrogen.

B. CHATTERJEE, Sibpore.

Studies have been made on the removal of sulphur from powdered samples of a specimen of cast iron (Mn, 0.58% and S, 0.47%) and drillings prepared from two samples of steel, I (Mn, 5.53% and S, 0.22%) and II (Mn, 4.77% and S, 0.35%) on heating at 1000°C in a current of hydrogen containing 1.2 per cent by volume of moisture. The sulphur content has been found to decrease to 0.32% in cast iron in 8 hours, to 0.13% in steel I in 12 hours and to 0.078% in steel II in 28 hours. The results indicate that moist hydrogen can bring about desulphurisation even in samples, the manganese to sulphur ratio of which has a value higher than that corresponds to the compound MnS. These results are of interest in that it is believed that sulphur has a greater affinity for manganese compared to hydrogen.

## SECTION OF GEOLOGY AND GEOGRAPHY

*President :—*SHRI V. P. SONDHI, M.B.E., M.Sc., F.G.S.

### *Abstracts*

#### A. GEOLOGY

##### (i) Stratigraphy

#### 1. The Study of the Geology and Petrology and the Economic Resources of Barwaha, Madhya Bharat.

V. S. DUBEY and ARUP DEB, Banaras.

The Barwaha area is situated in Madhya Bharat about 36 miles South of Indore on the right bank of R. Narbada. The succession of the formations met with in the area is as follows :

Upper Vindhyan	Vindhyan Sandstones.
Bijawars (Cuddapahs)	Glacial tillites
	Hornstone breccia
	Dolomitic limestones
	Quartzites.
Archaeans	Metamorphics.

The metamorphic rocks mainly consist of quartz-chlorite and quartz-sericite schists; the metamorphism seems to be of a low grade and the quartzites do not show much strain effect. The Bijawars consist of the quartzite at the bottom, followed by dolomitic limestones and hornstone breccia. The strike direction is about N.E.—S.W. In places the limestone has been folded very much. At the end of this period there was a glacial ice-age in which tillites similar to those of the Bijawars of the Son Valley were formed. The origin of the Hornstone breccia and the tillites has been discussed in the paper.

Uranium and other determinations carried out by the senior author in the M.I.T. Cambridge on two specimens from the area give the following results :—

No.	Urx10 <sup>-6</sup> gm/gm	Rax10 <sup>-12</sup> gm/gm	a—counts	Ra equi Th	Th/Ur
1.	1.15	0.41	188	0.74—3.14	2.8
2.	1.20	0.42	190	0.75—3.14	2.6

These are very similar to those for other traps of the Bijawar age.

The iron ores and the Manganese ores are found associated with the hornstone breccia and in places the concentrations are enough to make them workable. The limestone and the dolomitic limestone found in the area are also of economic importance.



## 2. Geology of the Panna Diamond Deposits.

S. M. MATHUR, Calcutta.

The diamond deposits of the Panna area (in Vindhya Pradesh) stretching from north-east to south-west in a belt, 60 miles long and about 15 miles wide, are classified on geological basis, and each type is described in this paper. The ultra-basic agglomerate tuff found at Majhgawan is recognised as a primary deposit. The secondary deposits consist of three conglomerates that are associated with the Lower Rewa sandstone, Jhiri shales, and the Upper Rewa sandstone horizons respectively. The previous workers had recognised only two conglomerates, those associated with the Lower Rewa sandstone and the Jhiri shales having been regarded as one. A third type of the deposits is the detritus and alluvial gravels found in river terraces and on the surface, in the gorges cutting through the Kaimur and Rewa scarps, and the recent detritus in nala courses. An account of the regional geology is given including a description of the newly established Paisuni beds in the Rewa series.

## 3. A note on the Geology around Simultala, Bihar.

S. RAY CHAUDHURI, MIHIR BOSE and Others, Calcutta.

The area around Simultala is an Archaean tract. The oldest rocks are a group of sedimentary metamorphites ranging from pelites, psamopelites to psamites. The strike of foliation of these rocks is NE-SW with an average dip of  $45^{\circ}$  towards NW. The axis of regional fold and that of minute crumples in the pelites, are all parallel to the strike of the country rock. The argillites belong to the sillimanite-almandine subfacies of the amphibolite facies. But decipherable history of their metamorphism is chiefly a retrograde one. The Granite group (including granite gneiss and augen gneiss) covers the major part of the area. The gneissic granite probably invaded the pelites at the last phase of their metamorphism. The granite gneiss, bears foliation having the same NE-SW trend and a northwest-ward dip. The gneiss at places shows leptinitic character with typical granulitic texture. An augen gneiss, typically lineated by feldspar augens, invaded the region closely following the gneissic granite. A somewhat marked discordant relation between the foliation of the granite gneiss and augen gneiss was noticed near Goplamaran. The augen gneiss seems to have possessed some mobility during its invasion and shows the imprint of deformation which was still continuing. The granitic materials have permeated the pelites to varying degree and near granite they are often rich in microcline and biotite. The representatives of the pre-granite basic rocks are the amphibolites. They occur in bands, having a common orientation parallel to the regional strike and in some cases are associated with calc-granulites. The amphibolites too have been affected by the granite and sometimes are intricately veined by feldspathic material. They are often migmatized and near contact with granite yield segregations of pure amphibole. The later geological history includes the intrusion of a basic suite of rocks now represented by the metadolerites of limited occurrence.

## 4. On the Archaean rocks in the Southern Parts of Ratnagiri District, and in Goa.

K. V. KELKAR, Poona.

The paper points out the striking differences in the metamorphic grades exhibited by the Archaean rocks in the southern parts of the Ratnagiri district and

in the adjacent parts of Goa. (Lat.  $15^{\circ} 45'$  and  $16^{\circ} 30'$  N : and Longs.  $73^{\circ} 15'$  and  $74^{\circ} 0'$  E). The rocks in the southern parts of Ratnagiri are :

Shore sands, alluvium etc.

Laterite—primary, much secondary.

Deccan trap lavas, a few dykes and sills.

Infra-trappean (?) boulders.

Newer Dolerite—Gabbros, dolerites, more or less uralitised.

Granite—gneiss, its pegmatites etc.

Archaean. { Dharwarian—quartzites, mica-schists with garnet, staurolite, kyanite  
etc. Fine biotite and hornblende-granulitic gneisses,  
amphibole schists, crush-conglomerates etc.

Except for a small tract west of Kankavli where staurolite—and kyanite—bearing mica schists occur, most of the area is occupied by metamorphic rocks of the garnet zone. Exceptionally either a little sillimanite or diopside has been formed in schists traversed by pegmatites.

Rocks in the extreme south-west of Ratnagiri are characterised by cataclasis and belong to a much lower grade. Crushed sedimentary conglomerates with oriented pebbles and containing chloritoid etc. occur along the northern shores of Venguria taluq and at Malvan. These rocks appear to be parts of a band to which rocks in Goa also belong. Both the Dharwarian rocks (sericite quartzites, phyllites, a few epidiorites etc.) and the granite-gneiss in Goa, show much crushing, unlike the corresponding rocks in Ratnagiri. The crush-conglomerates etc. appear to mark a thrust zone which has abruptly terminated the Dharwarian rocks of the Ratnagiri district.

## 5. The Gondwana Basin of Sedimentation in India.

F. AHMAD, Calcutta.

A study of the epeirogenic conditions of the Gondwana period suggests that there is no evidence to support the view that the sediments were deposited in block-faulted basins, as suggested by Fox and others. Instead a broad exo- or auto-geosyncline is suggested for the entire eastern part of Peninsular India. The faulting, apparently, took place late in the Cretaceous Period, and the sediments on the upthrow side have since been completely denuded away.

The author points out that the use of the term Gondwana System is not in harmony with its use in other countries, and its subdivisions into Upper and Lower or Upper, Lower and Middle are uncalled for.

## 6. Geology of the Area Around Simultala, Bihar.

D. NIYOGI and BHAGWAN DAS, Kharagpur.

The paper is a preliminary report on the unmapped metamorphic terrain of Archaean rocks in about forty sq. miles. The area shows interesting assemblages of parametamorphics referable to amphibolite facies and produced from alternating sedimentary bands of argillaceous, gritty-arenaceous and calc-argillaceous sediments. Even the first two types of sediments are slightly calcareous. Metamorphosed equivalents of these types are recognised in (a) Hornblende-biotite-schists and mica-schists with profuse andesine, zoisite and epidote, (b) Micaceous and gritty quartzites with some hornblende and zoisite; (c) para-amphibolites with hornblende-andesine-biotite-quartz-diopside grading through garnet-amphibolites and calc-silicate rocks to andesine-epidote-quartzites. Perfect gradation between the three types is seen both along and across strike.



A porphyritic granite has intruded the above rock-types. Four varieties, e.g., pegmatoid granite, porphyritic granite, foliated porphyritic granite gneiss and granite gneiss can be recognised. A typical porphyritic granite consists of dominant oligoclase, subordinate microcline, perthites, biotite and hornblende. Foliation and lineation are both considered to be relict. Some of the joints contain pegmatites and have displaced and twisted the foliation. The granite is thought to be the result of infusion of granitic material into country rocks with slight mobilisation in late stages.

## 7. On the Jungel Series.

S. M. MATHUR and KEDAR NARAIN, Calcutta.

This paper discusses the age of the Jungel series, which was called the 'Red Shale Series' by Oldham, Dutta and Vredenburg. It consists of conglomerate and (sandstone at the bottom, shales in the middle and sandstone on the top. The authors examined the series near the Mirzapur-Sidhi border where it occurs tightly pinched in within steeply dipping beds of the Transition sediments and is distinctly younger than the latter. Near Ramnagar ( $24^{\circ} 12' : 80^{\circ} 8'$ ) in the Sahdol district (Vindhya Pradesh there is a small exposure of the Jungel Series which is overlain unconformably by the Semris of the main exposure. It is, therefore, clear that the Jungel Series is younger than the Transitions but older than the Lower Vindhya. The Transitions are now referred to the Iron-ore Series and not to the Bijawars of the type area. The Jungel Series may therefore be considered contemporaneous in age with the Kolhan Series. Its association with the Transitions is similar to the relationship of the Kolhans with the Iron-ore series.

## 8. Geology of the area around Gaya (Bihar).

BHAGWAN DASS, Kharagpur.

On the basis of the age relationships among the various rock types—as determined during the field investigations and considering their lithological composition, relationships to the igneous intrusions and grade of metamorphism, the main rock types have been classified and correlated in a time sequence as follows :

Recent		Alluvium.	
Cuddapah or earlier		Meta-dolerite.	Meta-dolerite of Kodarma, Newer Dolerite of Singhbhum.
Post Dharwar.	Granitic rocks.	Pegmatites.	Dome-gneiss of Kodarma and Singhbhum granite.
		Microgranites.	
		Alkali-granites.	
		Adamellites.	
Upper Dharwar.		Epidiorites.	Dalma and Dhanjori Lavas
		Phyllite & quartzite.	Iron Ore Stage.

The oldest rocks of the area, sericite-chlorite-phyllite, micaceous quartzite and various types of epidiorites are product of low grade regional metamorphism of argillaceous and arenaceous (impure) sediments and basic igneous masses respectively. The various igneous granitic rocks have resulted from the progressive squeezing out of the consolidating magma under the orogenic stress and contamination and assimilation of the country rocks. The original rock of doleritic character which has intruded into the microgranite, on slight metamorphism has given rise to Meta-dolerite.

### **A Study of the Archaean formations in the vicinity of Girar, Jhansi District (U.P.).**

KRISHNA KANT SINGH, Kharagpur.

In between the contacts of Bundelkhand granites and the later Bijawars and adhyans, interesting types of rocks of Archaean sequence are met with in the vicinity of Girar (Lat.  $24^{\circ} 18' 30''$ —Long.  $78^{\circ} 56'$ ). The hills on the northwestern bank of the Dhasan river near Girar are made up of banded hematite-quartzites with intercalations of ferruginous phyllites. They dip  $50^{\circ}$ - $60^{\circ}$  in the  $N 10^{\circ} W$  direction. They show variation in the proportion of hematite and quartz and show evidences of minor faulting and folding. Similar types of rocks are met with at Baraitha.

On the northern slopes of the hills at Berwar, banded hematite-quartzites are preserved and further west become gritty and crumpled and schistose. These quartzites often show thin bands of greenish fuschite-quartzites. In between the Bijawars and Bundelkhand granites, thin bands of crystalline limestones and crumpled ferruginous shale are noticed.

It is suggested that the sequence of formations consisting of banded hematite-quartzites, fuschite-quartzites, phyllites and sheared gritty rocks are related to the middle Dharwarian formations.

### **3. A note on the Geology of the Vernoli Hills near Dandeli (North Kanara Dist., Bombay State).**

R. V. JOSHI and V. M. DEHAI-KULKARNI, Dharwar.

The Vernoli hills near Dandeli form a small range which lies in the manganese-bearing zone on the eastern margin of the Karwar District. The mining operations were facilitated detailed study of the deposit. The rocks encountered are laterite, granite-gneiss, and hematite quartzite; of which the latter shows NW-SE strike and high angle of dip towards east. Some dolerite dykes and pegmatites were also noticed. The manganese deposits show consistency in their occurrence on the dip slope. The pits dug in this area throw a considerable light on the disposition of the manganese ore of different grades. It occurs as a float ore, in the laterite, in the bedded form and also in the form of minute veins in the country rock. The high grade ore is found mainly on the lower slopes. Geological map and the profiles of the sections observed in the pits are given in this paper.

### **11. Some observations on the stratigraphy and tectonics of the region north of the Banihal Pass, Kashmir.**

P. C. HAZRA and K. N. PRASAD, Calcutta.

The area under report was previously mapped by R. Lydykker (1882), C. S. Middlemiss (1910) and D. N. Wadia with P. C. Hazra (1936). In 1952, while engaged on a special reconnaissance of the northern and southern slopes of the Pir Panjal range, the authors noted some additional geological details concerning the stratigraphy and tectonics of the region.

According to the authors, the dominant anticlinal structure (previously mapped) between Banihal ( $33^{\circ} 26' : 75^{\circ} 12'$ ) and Lower Munda ( $33^{\circ} 33' : 75^{\circ} 12'$ ) passes into a subordinate syncline at the crest of the Pir Panjal range. The traps at the southern portal of the present tunnel (high level) dip north-easterly whereas they dip south-westerly at the northern portal, thus proving the existence of a syncline previously not recorded.

Along the northern slopes of the Pir Panjal, the contact between the traps and the Zewans is demarcated by a reversed fault. The fault plane dips W.S.W. at



about 40–45°. The boundary between Zewans and the Trias is also probably faulted as seen near Munda saddle ( $33^{\circ} 31\frac{1}{2}' : 75^{\circ} 12\frac{1}{2}'$ ), although the fault is not so apparent when traced further north-westwards. The normal boundary in the adjacent area is, however, a distinct unconformity.

A small thickness of *Gangamopteris* bed bearing a new species of *Taeniopteris* has been discovered about 3 furlongs W.S.W. of Upper Munda ( $33^{\circ} 32' : 75^{\circ} 11' 25''$ ).

The Zewans and the overlying (? Upper) Triassic together with Jurassic formations are involved in closely packed isoclinal folds; shearing along fold axis is common. The regional strike is N.W.-S.E. with steady south-westerly or W.S.W. dips at angles varying between 50°–70°. Instead of a single band of Jurassic rocks as previously recorded, two bands have been mapped. The Jurassics are surprisingly unfossiliferous, but the authors succeeded in locating a horizon about two miles west of Verinag ( $33^{\circ} 32' : 75^{\circ} 15'$ ), which has yielded some recognisable fossils of Jurassic age.

## 12. Association of Carbonaceous Material with red clay bed in Panchet Stage South East of Raniganj Basin.

MILAN KUMAR SEN, Calcutta.

It is interesting to record from  $87^{\circ} 1' 20''$  E :  $23^{\circ} 33' 33''$ , a 6" wide carbonaceous band (moisture 4.67%, volatile matter 46.31%, fixed carbon 27.60% and ash 21.42% brownish ash, non caking) intercalated with brown ferruginous sandstone and band (3" to 9" thick) of red clay (Fe=22.21%). This is probably the first time, a band of carbonaceous matter has been reported from within the Panchet sediments of the Raniganj Gondwana basin. The red clay beds are usually 3 to 6 ft. apart.

It is suggested that the carbonaceous band intervened by red clay bands was deposited in the season of flood preceded by warm and followed by dry climate. Such association of organic matter with red bed has been reported earlier by Tomlins (1916) from Permo-Carboniferous and Triassic formations of Western U.S.A., and Medlicott & Blanford (1879) from the Siwaliks.

## 13. Geology of the area around Mandu, Hazaribagh District, Bihar.

A. GOSWAMI, Calcutta.

The area, consisting of sedimentary as well as igneous metamorphites occurring within the granite-gneiss as small thin lenses having N.N.W.-S.S.E. strike and easterly to northeasterly dip (amount varying between 50°–78°), lies in the Topographic Sheet No. 73E/5, 73E/6, 73E/9 within the lat.  $23^{\circ} 44'$  to  $23^{\circ} 51'$  and long.  $85^{\circ} 31'$  to  $85^{\circ} 31'$ .

The stratigraphical sequence is as follows :—

Gondwana system	{	Raniganj stage
		Barren Measure stage
		Barakar stage
		Talchir stage
Unconformity		
Archaean system	{	Granite gneiss
		Quartz-mica schist and Amphibolite

All the members of lower Gondwana from Talchir down to Raniganj lie unconformably over the Archaean. At places the boundary is faulted. Besides physical data, these sedimentary formations can also be distinguished by their heavy mineral contents: e.g. Talchirs with greatest amount of heavies (especially with garnet); Barren Measure with iron ores only, and Raniganj with abundance of zircon.

Coal seams, of variable thickness (maximum about 31 ft.) and of very good quality, are found to be associated with the Barakar shales and sandstones.

**On the Nature of the Talchir Beds of Satpura Coal Fields.**

K. P. RODE, Udaipur.

During a recent visit to the Ghorawari Collieries in the Upper Kanhan Valley, Satpura Coal Field, the author examined several sections within what have been mapped by G.S.I. as Talchir formation a few miles north of Hirdagarh R.S. Here Talchirs have been intruded by Deccan Trap dikes running for miles in roughly N. direction. A closer examination in the field clearly showed an organic relation-ship between the weathered traps and the Talchir shales in that the Talchir shales which are typical chrome coloured needle shales and coarsely bedded cuboidal fragmental shales often contained cores of less altered traps. This strongly indicated that the peculiar nature of the Talchir shales is due to their derivation from Deccan Traps under some special conditions of decomposition. An outcrop of identical Talchir Boulder bed is seen in the bed of Karaia nala near Bandh, along Tram line from Ghorawari to Hirdagarh R.S. The boulder bed contains huge blocks of granite, quartzite, dark trappean rocks, etc. all embedded in a chrome coloured fine clayey matrix. Quite adjoining this are the outcrops of a typical Deccan Trap mass showing the decomposition product identical with the matrix of the Boulder bed and this left absolutely no doubt that the boulder bed is only an accumulation of a variety of rock fragments caught up in a trappean mass.

This field evidence raises strong doubt about the sedimentary or even glacial nature of the Talchir boulder bed and the shales of this as also of most other areas where Talchir deposits of identical nature have been described.

It appears to the author that the Talchir shales are only trappean sills intruding the Gondwana formations like the Barakar sandstones, shales and coal seams and that some of the basal sills have suffered extensive decomposition through shearing during sheet movements imposing sedimentary characters on an essentially eruptive material.

**Occurrence of a Tertiary Lime-stone in Mewar State.**

T. V. V. G. R. K. MURTY, Udaipur.

In the course of a detailed investigation of the stratigraphy and tectonics of the Ravalli ranges the author met with a limestone at two places, one at the 10th milestone on the Udaipur-Gogunda Road and the second about  $\frac{3}{4}$  mile west-north-west from the first occurrence.

The limestone has been observed by Heron, who described it as a calc-tufa. In lithological aspect the rock is widely different from the Raialo limestone which occurs in the nearby area. Besides there is a conglomerate in which pebbles of all the older rocks can be identified.

The limestone is richly fossiliferous, containing a few Gastropods while the effaceous limestone has abundant Dicot- and Monocot-leaf impressions. The Gastropods indicate a minimum age of Tertiary and the plant impressions suggest a much younger age.

**The Stratigraphical Position and Classification of the Transition Series in the Son Valley.**

S. M. MATHUR, Calcutta.

The paper deals with the Transition sediments of the Son Valley which have been hitherto considered equivalent to the Bijawar Series. The author has recently



re-mapped the area, and has found evidence to suggest that they are referable to the Dharwars. The following classification has been tentatively suggested:—

*Son Valley*

Agori Series	{	Calcareous chlorite schist (with iron shales).
		Upper jaspidious beds.
		Karji slates and shales.
		Lower jaspidious beds.
		Bhitri shales
Parsoi Series	{	Banded-haematite-jasper.
		Ferruginuous quartzites, limestone and shales.
		Shales, phyllites and schists (and associated gneiss).

**(ii) Palaeontology and Palaeobotany**

**17. On the Laki Formations near Khewansar (Rajasthan).**

S. N. SINGH, Lucknow.

Systematic collection of Laki fossils was made from localities, 40 miles north of Jaisalmer town during October, 1950, from hills west and southwest of Khewansar. The sequence of the Laki beds, which overlie the Parihar sandstones is as follows:—

3. Grey shales—Thickness 10 ft.—with *Assilina granulosa*, *A. leymieri* and *Nummulites* spp.
2. Chalky band—Thickness 30 ft.—with echinoids and *Nummulites* spp. *Lockhartia* spp., *Orbitolites complanatus*.
1. Hard white limestone—Base not seen—with *Nummulites* spp., *N. alacicus*, *Assilina* spp., *A. cf. spinosa* and in the lower part of the limestone shells of gastropods, lamellibranchs and brachiopods are present along with the above foraminifera.

The associated foraminifera indicate a Middle Laki age for these beds. The faunal assemblage of chalky band is remarkable for the presence of dwarfed echinoids between 2 to 3 mm. in diameter.

**18. A Preliminary study of Microfossils in Coal Seam No. X, North Damud Colliery, Jharia Coal Field.**

D. LAHIRI, Calcutta.

A number of samples of coal of seam No. X was collected from North Damud Colliery for microfloral study. On maceration with Schultzes' Reagent the sample yielded a small number of spore bodies and a large number of fragments of tracheids and other woody elements. The fragments of tracheids had both uniseriate and multiseriate pittings. A few thick cuticle cells were also observed. Consistent paucity of spores suggests that the coal especially of this region was formed of woody stems.

**(iii) Mineralogy**

**19. Note on the Feldspars of the Charnockitic rocks of the Mor Valley, Sontha Parganas, Bihar.**

S. C. CHATTERJEE, Patna.

The feldspars occurring as porphyroblasts in the intermediate charnockites and associated granitic gneisses of the Mor valley have been studied with the help of

the Federov Universal stage with a view to their specific identification. The results show that the albitization of older diopside gneisses has caused charnockitization and the influx of pegmatitic pink microcline feldspars has caused granitization of the older rocks.

## 20. On the Occurrence of Beryl in Madhya Pradesh.

SRIPADRAO KILPADY and A. S. DAVE, Nagpur.

The paper records the occurrence of beryl in a granite pegmatite from Tirodi, Balaghat district. This is the first reported occurrence of beryl in Madhya Pradesh. The crystals of beryl occur disseminated but locally concentrated around pods in association with tourmaline, manganapatite and spessartite in a coarse pegmatitic groundmass consisting of pink microcline perthite, white altered albite and books of green mica.

The crystals of beryl are usually small in size, pale to bluish green and dirty yellow in colour with prominent basal parting and slender to stumpy prismatic habit. The hardness is 7.5 to 8 and specific gravity is 2.696. Biaxial negative with a very small optic axial angle. Refractive indices:  $e=1.57-1.58$ ;  $w=1.58$ . Birefringence:  $.0035-.004$ . If in the formula  $Be_3 Al_2 Si_6 O_{18}$ , the alkalis iron, magnesium and calcium are assumed to proxy for Be, then the percentage of BeO in the specimen can be said to approximate to 13. Crystals often show alteration to a soft, white kaolinitic product.

## 21. Surface Features of Magnetite.

C. RAMASASTRY and S. V. LAKSHMI NARAYANA RAO, Kharagpur.

A magnetite crystal with a high degree of natural polish obtained from F. Krantz & Co. exhibited an arrested growth in developing into a dodecahedron from an octahedron. Large number of closely spaced parallel growth lines were observed on the developing faces, which are parallel to the crystal edges. The smallest spacing between these lines, as measured directly by a precision Hilger Comparator and also from a photo-microgram should be an integral multiple of the unit cell. The growth lines mark the edges of small flats (surfaces) of different heights.

## 22. Triclinic Chloritoid from N. E. Mayurbhanj and its Optical Characters.

KSHITINDRA MOHAN NAHA, Calcutta.

Chloritoid was described by Tschermak as a monoclinic mineral. But some of the subsequent workers found triclinic symmetry in some chloritoids. Chloritoid has been observed in mica-schists in N.E. Mayurbhanj and was particularly examined on the Universal Stage.

The colour of the mineral is unusually feeble, presumably due to high Mg-content, and the pleochroism is weak, with the scheme, X—pale green, Y—pale slate blue to ash blue, Z—very pale yellow to colourless;  $Y > X > Z$ .  $N_y=1.714$  to  $1.716 \pm .002$ .  $N_z-N_x=.0077$ .  $2V_z$  varies from  $37^\circ$  to  $52^\circ$ , rarely reaching  $60^\circ$ . Polarization brushes have been observed in sections perpendicular to optic axis. Cleavage is micaceous parallel to (001), with fairly good cleavage along (110) and  $(\bar{1}\bar{1}0)$  at an angle of  $60.5^\circ$  with each other.  $(001) \wedge (110) = 84^\circ 20'$ . Lamellar twinning with (001) as the composition face is common, with twin axis near [310] (taking the angular relations of the monoclinic cell). Occasional penetration-twin has been detected under high magnification, and twins with rotations axis near  $\perp 001$  and presumably coinciding with c-axis have been observed.



$Z \wedge \perp 001$  varies from  $10.5^\circ$  to  $14^\circ$ ,  $Z \wedge c = 13.5^\circ$ ,  $c \wedge 001 = 11^\circ$  giving  $B$  ( $c \wedge a$ ) =  $101^\circ$ .  $X \wedge (001)$  varies from  $3^\circ$  to  $13^\circ$  and  $Y \wedge (001)$  varies from  $1.5^\circ$  to  $11^\circ$ . Even when  $X$  or  $Y$  lies in (001) plane, neither of them coincides with  $b$ -axis. The crystal symmetry is thus triclinic, with  $X$  near 'b' and  $Y$  near 'a' crystallographic axis.

Chloritoids from near Mosabani and from near Panijia in E. Mayurbhanj also show triclinic symmetry.

### 23. Microscopical study of Ilmenite and other opaque minerals and the associated rocks from Bhaluwari, Gaya district.

BANKIM MUKHERJEE, Calcutta.

The occurrence of mica and ilmenite in Bhaluwari was reported in a paper submitted last year to the Science Congress. The microscopical characters of the minerals, especially the opaque ones, are now given.

Mica occurs in pegmatitic quartz veins associated with granite and other metamorphites as hornblende schist and muscovite-biotite gneiss. The former contains epidote and zoisite. The gneiss contains potash feldspar showing  $2V_x = 43^\circ 30'$  (orthoclase). Feldspar of the mica pegmatite is perthitic with  $2V_x = 82^\circ$ .

The opaque mineral in granite is Ilmenite. Under the ore-microscope Ilmenite was the predominating constituent. Next in abundance are Hematite and B-hematite (after Dunn). Reflectance measurement by Berek Slit Microphotometer using a green filter gave the values of 18.32% for Ilmenite, 25.86% for Hematite and 20.20% for Magnetite.

Textures were studied in detail. The minerals occurred as xenomorphic aggregates. Magnetite was almost wholly martitised. B-hematite replaced hematite largely, reducing hematite to only small patches and streaks in a mass of B-hematite, at places. Relation between Ilmenite and Hematite is one of substitutional solid solution in which unmixing occurs. The ex-solution bodies of haematite occur as small strings in ilmenite and under low magnification give the appearance of string perthites. At high magnification this hematite is seen as separate and distinct blades in ilmenite.

### 24. Deformation-Lamellæ in Quartz from Granophyric Granite and Diorite of Butgora-Sarjori area, Eastern Singhbhum.

AJIT KUMAR SAHA, Calcutta.

Deformation-lamellæ in quartz have been noted from a specimen of granophyric granite near Sarjori ( $22^\circ 32' : 86^\circ 20'$ ) and a specimen of diorite, north of Butgora ( $22^\circ 33' : 86^\circ 20'$ ). Statistical study of lamellæ-orientation in the specimen of granophyric granite, which shows a rude banded arrangement of quartz grains, indicates the presence of three sets of lamellæ. The average positions of sets II and III, which make an angle of  $78^\circ$  between themselves, intersect approximately on the visible foliation-plane, the line of intersection being regarded as the  $b$ -fabric axis; set III is approximately parallel to  $bc$ . Fabric-diagrams of quartz— $C_v$  in the same rock (i) for grains with lamellæ and (ii) for unselected grains show fairly well-developed  $bc$ -girdles. Unlike the previous investigators, the author finds dominance of large  $C_v \wedge \perp L$ , which is explained by the fact that most lamellæ are oriented parallel to  $b$ , with which most quartz  $c$ -axes in this rock make small angles.

It is suggested that the lamellæ sets I and II are the effects of transport along  $a$ , while set III is due to transport along  $b$ , during the same triaxial deformation. Textural relationships of quartz, in these as well as associated rocks, to regional deformation, indicates that the lamellæ are possibly due to a mild effect of shear movements which produced the main thrust-zone of Singhbhum.

**25. The Mineralogy of the Beryl Group.**

M. W. CHAUDHURI, Udaipur.

The beryls from Rajasthan pegmatites often carry multitude of inclusions of microscopic dimensions. Detailed optical study has revealed that these inclusions are of Leucophanite, Meliphanite, Epididymite and Eudidymite. Indications of the inclusions of Bavenite and chrysoberyl require further confirmation. These inclusions strictly observe definite crystallographic relations with the host beryl, and are of the nature of Widmannstätten structure. Detailed optical and structural work indicates that these minerals are the exsolution products of an initially highly alkaline beryl.

**(iv) Petrology****26. A Note on the occurrence of Ellipsoidal Lava near Kantapali, Sundargarh district, Orissa.**

P. C. HAZRA and Y. G. K. MURTY, Calcutta.

The lava belongs to the volcanics of the Iron-ore Series. It consists of ellipsoids of 2 to 3 inches in size containing albite-oligoclase, hornblende and scanty magnetite in a groundmass almost entirely made up of coarse prisms of hornblende with minor amounts of magnetite and traces of plagioclase. The various probable modes of origin include (1) metamorphism of original pillow lava, (2) metamorphism of normal vesicular lava and (3) differential migration of plagioclase and hornblende due to shearing. They have been discussed and it is suggested that the first appears to be the most probable one in the present case.

**27. On the pelites of the area around Simultala, Bihar.**

MIHIR BOSE and S. RAY CHAUDHURI, Calcutta.

The pelites which constitute the oldest members of the rock sequence in this area ( $23^{\circ}40'$  to  $23^{\circ}45'$ :  $86^{\circ}30'$  to  $86^{\circ}35'$ ) occur in close association with widely occurring gneissic granite. The foliation strike of the argillites corresponds to the regional strike, commonly NE-SW, and the foliation dip is usually high towards NW. The frequent development in the schists of minute open folds with axes parallel to the foliation strike, indicates a prevalence of *b* lineation. The incompetent argillite shows greatest imprint of deformation and the joints are better developed in the arenaceous metamorphites. The occurrence offers a favourable field for study of metamorphism and hybridism of the pelites which belong to the Sillimanite-Almandine subfacies of the amphibolite facies. Quartz, sillimanite and almandine are chief constituents. Microcline shows antipathic relations to sillimanite. But the different mineral assemblages encountered show that the pelites have been rendered mineralogically simple by subsequent diaphoresis. The argillites have been affected by the regional granite invasion. The frequent replacement of the aluminous index mineral sillimanite by hydrous micas, the profusion of microcline, the presence of plagioclases of oligoclastic composition, the richness of biotite with regeneration of coarse flakes and biotitisation of hornblende and garnet besides sillimanite, are all some of the effects of granitisation on the pelites. The final effect of the granite has essentially been a retrogression on the pelites lowering them to the Staurolite-Kyanite subfacies.



## 28. Petrography of the Ultrabasic Intrusives of Aurnaga-Koel Valley, Palamau, Bihar.

RAGHUJI VERMA, Ranchi.

The Auranga-Koel valley in the topo sheet No. 73 A/1, is dominantly occupied by gneissic complex which have been intruded by a system of numerous basic to ultrabasic intrusives. The intrusive rocks are comprised of ultrabasics, gabbros, norites, diorites and dolerites. In this paper are discussed the macroscopic and microscopic characters of ultrabasic rocks as are found occurring in this area. The following types of ultrabasic rocks have been recognised by the author:—

### A. Olivine free types:—

1. Hypersthenites,
2. Hypersthenic Hornblendites.

### B. Olivine rich types:—

1. Pyroxenites rich in Olivine.

## 29. The Heavy Minerals of the Kamthi Sandstones.

SRIPADRAO KILPADY and G. G. DESHPANDE, Nagpur.

The paper presents a report on the heavy mineral analysis of the Kamthi sandstones from the type locality of Silewada in Nagpur Tahsil, Madhya Pradesh. The percentage of the heavy minerals in these rocks is found to range from about 0.138 to 1.337. Ilmenite and Manganese ore flood all the samples; Zircon, Epidote, Rutile, Apatite and Tourmaline are quite common and Sillimanite, Kyanite, Staurolite, Allanite (?), Blanfordite, Garnet, Dumortierite, Piedmontite, Hornblende and Pink amphibole are present only as trace minerals. The provenance as indicated by the assemblage taken as a whole appears to be the Manganese-bearing Metamorphic and Igneous rocks of the Sausar series.

## 30. A Preliminary Note on the Petrography of the area around Jhansi.

G. W. CHIPLONKAR, K. C. DUBEY and P. S. AGARKAR, Saugor.

The area under consideration lies between the latitudes  $25^{\circ} 8' - 25^{\circ} 35' N.$ , and longitudes  $78^{\circ} 23' - 78^{\circ} 42' E.$  The most common rock is granite, within which are found xenoliths of hornblende-schist and quartzite. Hybridization of these pre-granitic rocks by the granite has given rise to good amount of variation within the granite. The main mass of granite is subsequently intruded by dykes of finer grained granite. Gneisses, wherever they occur, are purely local. Streaky gneisses are also observed and appear to be composite in origin. Pegmatites are associated with the granite. Basic dykes of gabbroidal, lamprophyric, doleritic and basaltic types are seen intruded into the granite. An acid dyke of granite-porphyry has also been found. A number of quartz reefs are observed to traverse the region, but in the field, the age-relations between the dykes and the quartz-reefs is not clear except in the case of a dyke of granite-porphyry which is crossed by a quartz reef and is thus definitely older than the reef.

The conclusions from the present study are:—

(1) That the granite in this area is a result of hybridism between hornblende-schist and quartzite on the one hand and a granitic material on the other, and that the hornblende-schist and quartzite represent the older rocks.

(2) That the granite has been subsequently intruded by dykes of finer grained granite, pegmatites, basic and acid dykes and quartz-reefs, the last being the youngest of all these.

**31. Sillimanite-kyanite association near Jamori, Sidhi district, Vindhya Pradesh.**

M. V. N. MURTHY, Calcutta.

West of Sidhi, near Jamori, in Vindhya Pradesh, a narrow zone of muscovite-chlorite schists, shows bluish-green 'knots' (composed of sericite) and occasional massive segregates (composed of sillimanite and kyanite or kyanite only). The two aluminosilicates which should not co-exist according to the phase rule, lie side by side even in the same thin sections and are not derived from (i) each other (by inversion or replacement) or (ii) from biotite as noted by Roy in Darjeeling District. The low grade schists were originally sillimanite-bearing biotite-schists. Metamorphic differentiation, aided by fluids, presumably gave rise to the segregations; under such physico-chemical conditions, both sillimanite and kyanite can probably crystallise together. The low grade schists result from retrograde metamorphism which converted sillimanite into sericite and biotite into chlorite.

**32. Note on the occurrence of Magnetite bearing Quartzites near Ramchandrapur, E. Manbhum.**

SAURIN SEN, Calcutta and BANKIM MUKHERJEE, Jadavpur.

Magnetite quartzite rocks, constituents of the metamorphites in E. Manbhum, occur as bands or lenses and often show lateral gradation to quartzites (pure or sillimanite-bearing). Associated sillimanite-almandine schists and diopside granulites suggest high grade of metamorphism up to the granulite facies. There are within the rocks thin bands and lenses of almost pure magnetite or magnetite-almandine, which suggest derivation by metamorphic differentiation. The rocks contain magnetite, almandine, quartz and accessory grunerite and apatite.

Under the ore-microscope only magnetite could be identified. The mineral, at times anisotropic, shows lamellae or intergrown ilmenite along the octahedral planes. The value of reflectance in air came to 20.86%. The texture suggests ex-solution derivation at comparatively high temperature.

**33. The Petrography of the Granites and Associated Khondalitic Rocks near Ranchi, Bihar.**

A. P. JAIN, Patna and R. VERMA, Ranchi.

The area studied lies within the Ranch district between  $23^{\circ} 19' 30''$  N and  $23^{\circ} 25' 15''$  N Latitudes and  $85^{\circ} 15' 15''$  E and  $85^{\circ} 23' 30''$  E. Longitudes, in topo sheet No. 73 E/7. This paper comprises the petrographic description of the following rock types:—

- (a) Khondalitic paraschists with graphite, garnet, sillimanite; Biotite schists; Quartzites etc.
- (b) Granites including microcline and biotite granites; granite gneisses, pegmatites and aplites.
- (c) Hornblende schists, hornblende pyroxene granulites, etc.

**34. Petrofabric Evolution in Zones of Regional Metamorphism around Kharsawan, Singhbhum District, Bihar.**

ANIRUDDHA DE, Calcutta.

Zones of regional metamorphism have been delineated on the sedimentary metamorphites of the Iron ore Series of the area ( $22^{\circ} 43' - 22^{\circ} 51' : 85^{\circ} 45' - 86^{\circ}$ ). A zone of intense penetrative movement, marked by lineation in a occur at the southern part of the area. Effect of shearing becomes less apparent in the higher



grades to the north, but the lineations in *a* persist. Quartz from *chlorite zone* rock shows a strong peripheral *bc* girdle with 11% maxima at *b*, the maxima III is also present in some cases and the deformation lamellae of quartz indicate slight movement parallel to *b*. In the *biotite zone* mica schist these two maxima are well developed in a broad *bc* girdle and the mica diagram shows *bc* girdle with maxima at *c* and intermediate maxima  $b \wedge c$ , indicating subordinate puckering parallel to *a*. Quartz of *garnet-kyanite zone* mica schist shows similar *bc* girdle and maxima, and mica shows a cleft *bc* girdle ( $270^\circ$ ). In *sillimanite zone* the intermediate maxima is accentuated in the *bc* girdle of quartz which shows undulose bands; mica diagram shows *bc* girdle with 12% maxima at *c*.

The complete homogeneity of the fabric through these zones indicates that the shearing of the low grade rocks is due to the dynamic effects of the regional dynamothermal metamorphism which continued at a waning period when the higher grade rocks were still at a sufficiently high temperature for reconstitution.

### 35. A Study of Granites and Gneisses of the Auranga-Koel-Valley, Palamau, Bihar.

RAGHUJI VERMA, Ranchi.

The granites and gneisses in the Auranga-Koel-Valley, Palamau, Bihar, are described. The area is bounded by longitudes  $84^\circ 0'$  and  $84^\circ 15' E$  and latitudes  $23^\circ 50'$  and  $24^\circ 5' N$ . (Topo Sheet No. 73 A/1).

The granites and gneisses practically occur in every part of the valley, and are intruded by numerous basic and ultrabasic dykes. The following types of granites and gneisses are recognised in this area which often grade into one another.

- (1) A medium to coarse grained granite or gneiss with subordinate banding.
- (2) A distinctly foliated banded gneiss.
- (3) A porphyritic granite and gneiss.
- (4) Epidotised granite.
- (5) Pegmatites and Aplites.

### 36. Petrology and Metamorphic facies correlation of Amphibolites of the Archaean Region Northwest of Abhayapuri, Assam.

BINAYENDRA NARAYAN NIYOGI, Calcutta.

The amphibolites of the area ( $26^\circ 22' : 26^\circ 29'$ ;  $96^\circ 31' : 90^\circ 41'$ ) may be grouped into two zones Eastern and Western, the grade of metamorphism increasing from East to West. They may be referred to the amphibolite facies. The garnetiferous and non-garnetiferous amphibolites occur in close association; (i) non-garnetiferous amphibolites contain hornblende ( $Ng=1.722$ ), biotite (Z-dark brown), plagioclase ( $An_{34}-An_{42}$ ), epidote ( $Ng=1.772$ ); (ii) garnetiferous amphibolites contain hornblende (Z-deep green,  $Nm=1.656$ ), plagioclase ( $An_{45}$ ), epidote ( $Ng=1.766$ ); (iii) pyroxene amphibolites contain pyroxene ( $Nm=1.686$ ,  $Z \wedge c=38^\circ$ , Diopside<sub>88</sub>-Hedenbergite<sub>12</sub>), hornblende (Z-deep bluish green,  $Nm=1.662$ ) and plagioclase ( $An_{54}$ ). Assemblages containing epidote show less calcic plagioclase ( $An_{32}$ ) and pyroxene ( $Nm=1.696$ ,  $Z \wedge c=42^\circ$ , Diopside<sub>56</sub>-Hedenbergite<sub>44</sub>). Contant accessory minerals are apatite and sphene. (iv) A variety of ultrabasic rock occurs on the northern side of the Sonakhuli hill ( $26^\circ 26' : 90^\circ 40'$ ) and shows anthophyllite ( $Nm=1.628$ ,  $Z // c$ , optically +ve) often altering to talc, tremolite ( $Nm=1.636$ ) and chlorite ( $Ng=1.572$ ). Assemblages (i) and (ii) are referred to the kyanite-staurolite subfacies and the content of iron oxide (12% in (i) and 14% in (ii).) controls the appearance of garnet. The assemblage (iii) may be referred to the almandine-diopside-hornblende subfacies (pyroxene hornfels). The presence of sphene relegates them below the granulite facies,

### 7. Textural Evolution in the Rajmahal Basalts, in the vicinity of Simra, Santhal Parganas, Bihar.

PRATIP KUMAR MUKERJEE, Calcutta.

The paper enumerates the studies on the textural patterns common in the basaltic lava flows of the Rajmahal volcanic tract, in the vicinity of Simra ( $25^{\circ}1\frac{1}{2}'N : 87^{\circ}20\frac{3}{4}'E$ ), Santhal Parganas. The present nomenclature of the textures in basalts has been discussed and the term "granulo-ophitic" has been proposed as the enclosing pyroxene here is not a single crystal but an aggregate of several crystals.

An attempt has been made, in this paper, at a broad correlation of the rate of cooling of the flows and the corresponding texture impressed on them and thereby establishing an evolutionary trend in the resulting textures. The evolution of textures in basalts from hyalo-ophitic to ophitic, through intermediate stages like intersertal, intergranular, granulo-ophitic etc., is essentially dependent on the rate of cooling of the lava in the different portions of the flows.

### 38. The Origin of Coronas around Olivine.

M. V. N. MURTHY, Calcutta.

The origin of coronas around olivine in rocks of the calc-alkaline gabbro clan, is explained in the literature as a result of (i) magmatic (ortho, or late) and (ii) metamorphic (thermal or regional) processes. It is concluded that magmatic reaction-rims may be formed locally during the crystallization of saturated basaltic magmas; the nature of the minerals forming the rims depends on the nature of the pyroxenes crystallizing in the groundmass. Shand's arguments regarding the improbability of late magmatic or deuteric reactions giving rise to rims, are borne out by the present studies. Observations, mainly from a study of corona-bearing olivine metadolerites from Dudhi tahsil, Mirzapur district, Uttar Pradesh are presented and a comparison has been made with magmatic reaction-rims, which show fundamental differences in the mineralogy of the rims and their structures. Existing views regarding the nature of the rim-formation are examined and Poldervaart's suggestion that the formation of orthopyroxene corona is brought about by reaction with water, is preferred. It is concluded that the conditions necessary for the formation of most of the coronas around olivine, are (i) high temperature (ii) time and (iii) amount of pore fluid. These conditions are often satisfied during thermal or regional metamorphism.

### 39. Tremolite-Actinolite rock from near Baraundhia, Monghyr District, Bihar.

PRASAD CHANDRA and PRIYASANKAR CHAKRAVARTY, Calcutta.

A few bands of tremolite-actinolite rock trending parallel to the regional strike (NE-SW) occur at the contact of amphibolites which form inclusions within a more prevalent granite-gneiss near Baraundhia ( $23^{\circ}41' : 86^{\circ}34'$ ). The amphibolites with the associated sillimanite-mica-schist show a high grade mineral assemblage corresponding to the amphibolite facies. The bands consist of coarse tablets and stunted prisms of light and deep green amphiboles with the individuals reaching a maximum length of 2.5 cm. Some acid plagioclase is associated with the amphiboles. The deep green variety shows a pleochroic scheme, X=pale yellow; Y=pale yellowish green, Z=pale green;  $Z>Y>X$ ;  $N_y=1.627+0.002$ . Twinning is present on (001)  $2V_x=79^{\circ}$ ;  $Z\wedge C=18^{\circ}$ . The light coloured variety is colourless in thin sections with the following optical constants.  $N_y=1.613+0.002$   $2V_x=88^{\circ}$   $Z\wedge C=20^{\circ}$ . A chemical analysis of the rock confirms it to be a tremolite-actinolite rock. Sometimes thin



pegmatite veins traverse the tremolite-actinolite bands and show an association of microcline-microperthite, quartz and oligoclase ( $2V_x$  nearing  $90^\circ$ ). The tremolite-actinolite rocks are thought to have originated from amphibolites due to permeation of the granitic materials and consequent reassortment of lime-rich portions. In thin slices, amphibolites show actual transformation from hornblende ( $2V_z=84^\circ$   $Nm=1.655$ ) to actinolite ( $2V_x=88^\circ$   $Nm=1.63$ ) along parting planes (001).

#### 40. Sedimentary Facies of the Charnockitic series.

S. NARAYANASWAMI, Calcutta.

Structural, stratigraphic and petrological studies of pre-Cambrian metamorphic complex, comprising charnockitic rocks, khondalites and garnetiferous gneisses, quartzites, quartz-magnetite granulites, calc-silicate granulites and pyroxene granulites, in Tinnevely and parts of Coimbatore and Trichinopoly districts in Madras reveal two stages of folding and deformation. A comparative study of the assemblage of rocks in charnockitic areas all over the Peninsular India suggests Eugeosynclinal facies of sedimentation involving the association of graywacke sandstone with interbedded greenstones, siliceous shales and siltstones, bedded chert, ferruginous chert, siliceous limestone and volcanic rocks. A critical comparison of the chemical composition and metamorphic features of rocks in charnockitic areas with rocks of geosynclinal associations indicates that (1) basic and ultrabasic charnockites correspond to basic and ultrabasic igneous rocks like basalts, greenstones, dolerites, gabbros and pyroxenites, (2) intermediate charnockites to Archaean graywackes, (3) acid charnockites to a syntectonic intrusive rock of acid granitic composition, and (4) khondalites and garnetiferous gneisses to pre-Cambrian siliceous and carbonaceous shales and siltstones. The ultrabasic and anorthositic rocks of charnockitic areas would correspond to such intrusives characteristic of the orogeny of Eugeosynclinal belts.

A study of the broad structural pattern in charnockitic areas reveals two stages of folding in comparison with a single stage of folding in non-charnockitic schistose Dharwars. The second stage of cross-folding in charnockitic areas should be attributed to later Dharwar folding about a North-South axis. On this basis, the charnockitic province would appear to be older than non-charnockitic schistose Dharwars. A tentative suggestion has been made, therefore, that rocks of sedimentary Eugeosynclinal assemblage have given rise to charnockitic rocks by a process of hypograde metamorphism and retrograde effects during repeated episodes of deformation, igneous intrusion and metamorphism. For a conclusive evidence on the origin of charnockites, it is suggested that correlation of rock series be made on regional, structural and stratigraphic basis in addition to purely petrologic and mineralogic studies.

#### 41. Kyanite-Chloritoid-Schists from North-eastern Mayurbhanj.

KSHITINDRA MOHAN NAHA, Calcutta.

Some muscovite-quartz-schists in a hitherto unsurveyed area in N.E. Mayurbhanj, between  $22^\circ 10' N$  and  $22^\circ 15' N$ , and  $86^\circ 33' E$  and  $86^\circ 38' E$  bear kyanite and chloritoid as well. They are thus of special interest as the two phases, kyanite and chloritoid, are believed to be incompatible in normal progressive metamorphism of argillites.

Detailed examination of the rocks shows that the whole region was subjected to a fairly high grade metamorphism resulting in the formation of staurolite-kyanite-schists from argillites. During the later stages of metamorphism, intense shearing took place resulting in post-crystalline deformation and destruction of kyanite, staurolite and muscovite, with occasional mylonitization. A prevailing high temperature during the waning stages of this tectonic movement caused re-

and neo-crystallization in the rocks, muscovite forming from kyanite, chloritoid from staurolite, and chlorite forming in the last phase from staurolite, biotite and chloritoid. Relics of kyanite and rare staurolite indicate the trends of these changes. Presence of a large number of minerals, petrographic evidence of replacement of one mineral by another, time-sequence of mineral formation with relation to movements, and association of minerals of proved different metamorphic grade clearly point to a metastable relationship, and prove their formation in more than one casting. The association thus represents a disequilibrium assemblage in a suite of polymetamorphosed argillites.

## 2. Norite Intrusions in South Dhalbhum and North-eastern Mayurbhanj.

KSHITINDRA MOHAN NAHA, Calcutta.

Four small bodies of noritic affinities occur within granite-gneisses between  $20^{\circ}12'N$  and  $22^{\circ}18'N$ ,  $86^{\circ}36'E$  and  $86^{\circ}41'E$  in South Dhalbhum and N.E. Mayurbhanj. The rocks are made up of plagioclase ranging from  $An_{66}$  to  $An_{76}$ , orthopyroxene (bronzite) and clinopyroxene (augite-salite), bronzite dominating over the clinopyroxenes. The pyroxene is often 'striped' with clinopyroxene lamellae in orthopyroxene host and vice versa, or with 'graphic intergrowth' between the two.

Differentiation is marked in the noritic mass around Birsinga ( $20^{\circ}13'30"N$ ,  $86^{\circ}38'30"E$ ) in Mayurbhanj, where norite (altered to uralite-norite and uralite-gabbro), anorthosite, altered ultrabasic rocks, a dioritic and a lamprophyric rock have been noted. All the rocks show extensive alteration, resulting in granulation of the primary minerals, and the formation of actinolite, prochlorite-amesite, scapolite, clinozoisite, calcite, sphene, tremolite, talc and rutile, with veins of tremolite, epidote and kyanite.

Glomeroporphyritic aggregates of plagioclase without any granulation or rupture of the grain borders even in the margin of intrusion, amphibole eating into feldspar from intergranular margins, optical continuity of detached granules of feldspar, total lack of schistosity in the rocks except a growth fabric near borders of intrusion,—all these indicate that the granulation is essentially chemical and not mechanical. Extensive crushing and occasional mylonitization of granite-gneisses in contrast with the total unsheared nature of the noritic rocks, together with an instance of a noritic vein occurring interstitially in crushed granite-gneiss are unequivocal evidences in favour of a post-gneissic age of the intrusions.

## 43. Sylhet Traps—a Local Petrographic study.

S. RAY and K. NAHA, Calcutta.

A few trap specimens were collected by Sri A. Chaudhuri of Calcutta University from near Laitiam ( $91^{\circ}45'15"$  Long.;  $25^{\circ}13'45"N$  Lat.) and Sohbar ( $91^{\circ}45'30"E$  Long.;  $25^{\circ}12'35"N$  Lat.) villages in the southern part of the Khasi Hills about midway between Cherrapunji on the Hills and Theria Ghat overlooking the plains. They include amygdular, almost aphanitic to coarsely crystalline porphyritic and non-porphyritic grey to black basalts. The average specific gravity is 2.85 with a maximum of 2.91.

The traps are made up of plagioclase in microlites (less than 0.05 mm. in length) and augite in granules with some iron ore forming fine-grained pilotaxitic basalts, with secondary chlorite (antigorite), montmorillonite, calcite and zeolite (laumontite) or they are made up of coarse-grained ophitic plates of augite enclosing plagioclase, with some iron ore forming coarse doleritic traps. Secondary minerals are equally profuse in both the types.

It is of interest to recall that Palmer's Sylhet Traps from further east in Khasi Hills were described as andesites containing hornblende, while Medlicott's traps



from the present and surrounding localities contained much olivine and were correlated with the Rajmahal Traps. The present specimens are basalts, without olivine and hornblende. They are very rich in pyroxene and may owe their composition to sinking of pyroxene in thick individual flows.

#### 44. The Metasomatic Diorites of Eastern Singhbhum.

AJIT KUMAR SAHA, Calcutta.

In the country between Kudada ( $22^{\circ}42' : 86^{\circ}12'$ ) and Butgora ( $22^{\circ}23' : 86^{\circ}20'$ ) in Eastern Singhbhum, the diorites along with the associated leuco-granites, granodiorites and the older metamorphic rocks, viz. phyllites, secondary quartzites, epidiorites, actinolite-schists etc., show a striking structural unity as regards foliation, lineation and joints. These structures formed in two different periods—(i) the earlier mineral-foliation ( $S_1$ ) with its associated linear structures (both *a* and *b*-lineations) and joints, produced during the metamorphism of the argillites and the associated basic rocks; and (ii) the later shear-foliation ( $S_2$ ) with a striation-lineation, and accompanied by sericitisation, chloritisation and tremolitisation. In the field, the diorites grade to the granodiorites, the basic metamorphic rocks and gabbros (near Butgora). In the basic rock-diorite-granodiorite sequence, there is progressive increase in the proportions of plagioclase and quartz, in the soda-contents of plagioclase and hornblende and a progressive addition of a late albite or microcline, while chemical analyses indicate progressive increase in  $SiO_2$ , alkalis,  $Fe_2O_3$  and  $FeO$ :  $MgO$  ratio and decrease in  $MgO$ ,  $FeO$  and  $CaO$ . The essentially post-kinematic crystallisation characteristics of the granites, granodiorites and diorites suggest that the mineral-foliation ( $S_1$ ) with its associated lineation and joints in them are largely mimetic after structures in the pre-existing rocks, later replaced to produce the diorites, granites etc.

It is suggested that the pre-existing basic metamorphic rocks and gabbros were transformed into diorites and granodiorites and the argillites to leuco-granites through metasomatic processes brought about by granitic fluids. These replacement processes started during the waning phase of the earth-movements which gave rise to  $S_1$ . During a late stage of these replacement processes, a shearing movement, possibly contemporaneous with the development of the main thrust-zone of Singhbhum gave rise to  $S_2$ . Post-dating this shearing, some albite, microcline and quartz were introduced into the diorites, granodiorites and leuco-granites.

#### 45. On some Shear-zone Epidiorites from South of Tatanagar, Bihar.

A. K. BANERJI, Calcutta.

In the region immediately to the south of Tatanagar and extending for about two miles in that direction a large number of small outcrops of epidiorite occur in the garnetiferous mica-schists and quartz-mica-schists which constitute the country rocks and belong to the Chaibasa stage of the Iron Ore Series developed in these parts of Singhbhum. By detailed mapping six epidiorite dykes have been recognised in the area. These were originally basic intrusive dykes into the Singhbhum geosynclinal trough prior to its deformation caused by mountain-building forces directed from the north. It brought about folding, shearing, thrusting and metamorphism in its wake. The already solidified basic dykes acted as lines of weakness along which movement and circulation of fluids took place with facility and allowed reactions to proceed more rapidly than in the surrounding pelites. As a consequence the epidiorites were metamorphosed to a higher grade than the surrounding pelites. The epidiorites show such mineral assemblage as andesine-hornblende and belong to the amphibolite facies of Turner involving metamorphism under strong deformation, high pressure and shearing stress. The

sociated pelites indicate a lower grade of metamorphism in that they belong to the albite-epidote-amphibolite facies of Turner involving strong deformation but slightly lower pressure and lack of shearing stress corresponding to the garnet grade of regional metamorphism.

### 3. Notes on the rocks (Deccan Trap) of Parnera, Dungri Billimora and Gandevi, Surat District, Bombay.

R. N. SUKHWALA, Bombay.

The five separate spots of Parnera ( $72^{\circ}57'E : 20^{\circ}35'N$ ) Sarangpur ( $73^{\circ}4'E : 20^{\circ}35'N$ ); Dungri ( $72^{\circ}58'E : 20^{\circ}41'N$ ), Billimora ( $72^{\circ}57.5'E : 20^{\circ}46.5'N$ ) and Gandevi ( $73^{\circ}E : 20^{\circ}48.5'N$ ) lie to the north of Bombay at a distance of about 125 miles to 160 miles along the Western Railway.

Except Gandevi and Billimora, where laterite or lateritic clay samples were found, in other places samples of basalts (Deccan Trap) were collected. Two features were conspicuous in Dungri basalt: (a) phenocrystal feldspar occurred in clusters of 2-3 feet in diameter, which when observed in a dug trench of about 5 feet, appear to have been restricted to the upper horizon; (b) in two samples of basalt, phenomena of arrested reaction (pyroxene—hornblende (?) or biotite (?) ) with separation of quartz and apatite could be studied.

In Billimora, samples of clay and basic trap were collected from two bores (1000' and 130') in two nearby localities. Little north-east of Billimora, in Gandevi laterite was seen exposed. Comparing bore samples with surface exposures and other relevant data, a surmise of a north-south trending fault has been made.

In Sarangpur, samples of basic trap were collected from seven dykes cutting two lava flows, exposed within a short distance of about four miles of the Auranga river bed. In a few dykes pyroxene revealed reaction rim phenomena (pyroxene—hornblende).

### 47. Occurrence of Quartzite Band near Karwar (Bombay State).

R. V. JOSHI and M. S. HONRAO, Dharwar.

In a recent survey of the area around Karwar one hitherto unnoticed band of quartzite was observed near the village Halge about 9 miles east of Karwar. The rock is extremely weathered and occurs as boulders on the slope of the laterite hill. A large number of pebbles of the same rock was noticed in the laterite quarries adjacent to this place as well as near the village Mukheri. The continuity of the band could not be established but it seems that the major portion of it has been weathered out and its remnants got concealed under the detrital laterite. It belongs to metamorphic formations of this area. Under microscope the rock shows an even grained mosaic structure of quartz grains.

### 48. Petromineralogy of the Rajmahal Traps, Santhal Parganas, Bihar.

SUBHENDUKUMAR BAKSI.

The area in the Rajmahal Hills within the latitudes  $24^{\circ}45'0''N$  and  $24^{\circ}50'0''N$  and longitudes  $87^{\circ}25'0''E$  and  $87^{\circ}35'0''E$  has been geologically mapped. The Rajmahal Traps with intertrappeans are the dominant formations with Archaeans, Talchirs, Barakars and Dubrajpurs. The primary constituents of these traps are plagioclase, pyroxene, iron ore, glass and apatite. The secondary ones are the palagonitic group of minerals together with late-silica-minerals, zeolite and calcite.

The plagioclase feldspars are of two generations—the groundmass and the phenocrysts. The groundmass feldspars have composition  $An_{36}$  and  $An_{46}$  and have



length-breadth ratio 2.9-5.0. On the other hand the phenocrysts range between  $An_{67}$  and  $An_{73}$  and have length/breadth ratio 1.5-2.0. Similarly the pyroxenes are distinctly of two species. The groundmass pyroxenes are pigeonite ( $2V_z = 10^\circ$  to  $28^\circ$ ) only. The phenocrysts are exclusively augite ( $2V_z = 44^\circ$  to  $54^\circ$ ). Next in importance are bars of magnetite, irregular patches of ilmenite, and glass, varying in amount from 1% to 44%. A few microlitic needles found embedded in glass are thought to be apatite. Of the secondary constituents there is a group of minerals, classed by the author under the name palagonite. The colour of the minerals varies from pale-bluish-green to dark-reddish-brown with concomitant variation in refringence and they are characteristically associated with chalcedony and not with chabazite". The late-silica-minerals are quartz, chalcedony agate and jasper. Calcite seems to be the last mineral to crystallise, filling the vesicles.

#### 49. Fabric of the Boileauganj Quartzites above the Jutogh Thrust within the Simla Klippe.

PRITHWISH KAR, New Delhi.

In the area around Simla where three major thrusts were recognised by Pilgrim and West, the older members of the Jutoghs, the Boileauganj Quartzites, occupy in the form of a highly recumbent and thrust anticline, and appreciable large area around Boileauganj ( $30^\circ 6' : 77^\circ 8\frac{1}{2}'$ ). Broader structures and fabric of specimen of this structural component have been studied. Besides quartzites, the Boileauganj Quartzites include such variants as quartz-schists, quartz-mica-schists, mica-schists and phyllites (phyllonites)—the latter two types being often garnetiferous. Specimens for fabric analyses have been collected at particularly close intervals west and east of Kasumpti ( $31^\circ 4\frac{1}{2}' : 77^\circ 11\frac{1}{2}'$ ), where all the three thrusts are shown.

The Boileauganj Quartzites have been found affected by persistent folding even on a small scale, so that the units now resemble almost horizontal, rather crumpled sheets, with occasional monoclines and local, steeper, overfolds. The folds commonly have well-marked pitches. Small faults, well-developed joints and lineation mostly marked by striations at low angles to the direction of dip (*a*) and in a few cases sub-parallel to strike (*b*) are also noticeable in these rocks. Minute pucker parallel to strike give rise to *b* lineation. Carbon Phyllites of Upper Stage show broader puckers along dip and strike.

Quartz axes diagrams of the rocks reveal peripheral *ac*-girdles, well-developed with maxima positions near II and V. One diagram of garnetiferous mica-schist shows a broad peripheral girdle with considerable scatter elsewhere.

#### 50. A Preliminary Note on the Sheared Zone of the Auranga-Koel-Valley, Palamau Bihar.

RAGHUJI VERMA, Ranchi.

In the course of geological mapping of the area the author has come across a well-defined crushed zone whose width varies from  $\frac{1}{2}$  to  $\frac{1}{4}$  of a mile. It extends from Ranimai Pahar ( $23^\circ 52' : 84^\circ 0' 30''$ ) in a north easterly direction through Baghpahari, Baria Chhoti, Khapia, Hatma Pahar up to Kechki railway station—a little more than eight miles in extent in Topo Sheet No. 73 A/1.

Some Zeolites have also been found to occur in the cracks and interstices of the rocks of this zone. The rocks of this belt have been grouped as follows:—

1. Rocks with moderate shearing and crushing,
2. Rocks that are highly sheared and crushed but not mylonitised,
3. Rocks that are almost mylonitised,

**51. A Study of the Bundelkhand Granite in Chhatarpur District, Vindhya Pradesh.**

A. G. JHINGRAN, S. M. MATHUR, S. N. PURI AND R. S. SHARMA,  
Calcutta.

The paper deals with a study of a part of the Bundelkhand Granite in Chhatarpur District, Vindhya Pradesh. Detailed observations regarding joints and mineralogical and textural variations in the granite have been made over an area of about 350 sq. miles in sheets No. 54 O/8, and 54 P/5 & 9. The granite as a whole shows immense variation both in mineralogical composition and texture. No less than six varieties are recognisable in field and it is further observed that they often occur very much intermixed with each other, there being frequent changes from one variety to another at short distances. Under the microscope significant textures and structures, *e.g.*, myrmekite, perthite, granular and sutured textures, corroded margins, and pseudo-mylonitic texture etc. are noticeable.

A very large number of fine to coarse grained, dark coloured, and often hornblende- and, or, chlorite-rich xenoliths have been observed embedded in the granites. They vary in size from extremely small, less than half an inch across, to as large as 20 ft. x 5 ft., sometimes even forming masses of the size of small hillocks. In some cases their margins are sharp while in others they interdigitate into the granites.

It has not been possible to come to any conclusion regarding the mode of origin of the granites at this stage but there are indications suggestive of their being formed through a process of granitisation, at least in parts.

**52. A Study of Bundelkhand Granites and the Associated Rocks around Heerapur in the North-eastern Corner of Sagar District, Madhya Pradesh.**

K. C. DUBEY, Saugar.

The paper deals with the geology of the Bundelkhand granites and the associated rocks in the area between latitudes  $24^{\circ}20'$  :  $24^{\circ}25'$  N. and longitudes  $79^{\circ}10'$  :  $79^{\circ}15'$  E., in the north-eastern part of Sagar district, Madhya Pradesh. The rock formations present are the so-called Bundelkhand Gneiss, consisting both of the granitic and gneissic elements, quartzose schist, basic dykes, pegmatites and quartz veins. Bijawars unconformably overlie them.

As far as the dominant rock is concerned, the term Gneiss is a misnomer the rock being in all aspects a granite. The quartzose schist is supposed to be xenolithic and to belong to the same group as the Mahroni or Maraura schist. Uralite gabbro, a green-stone dyke and a chlorite schist are the basic rocks encountered. The field and microscopic study of these dykes and the degree of metamorphism undergone by these rocks tentatively suggest that the dykes may be pre-granitic in age.

**53. A Note on the Quartz-veinlets in the Bijawar Limestone, Heerapur, Sagar District, Madhya Pradesh.**

K. C. DUBEY, Saugar.

Quartz veinlets have been encountered in the Bijawar limestone at Heerapur ( $24^{\circ}22'$  N. :  $79^{\circ}13'$  E.) in the north-eastern corner of Sagar district, M. P. Quartz reefs are reported to be intrusive into the Gwalior sandstone by Krishnamurty Rao. Though no reef as such is found in the present area, it is suggested that



as in Rajputana, so in the Bundelkhand area also, igneous activity in the form of intrusion of quartz veins and reefs, may be of two ages—one, post-granitic and pre-Gwalior and other, post-Bijawar. The former possibility is supposed to be more likely in view of the composite nature of the reefs themselves.

#### 54. Basification and Granitisation of the Metaandesites and the Associated Sedimentary Quartzites of Dongargarh Tahsil, Drug District, Madhya Pradesh.

S. N. SARKAR.

In Dongargarh tahsil, Drug district, the pyroxene andesite lavas and their hypabyssal phases, pyroxene diorites have been metamorphosed into epidiorites and amphibolites and often show evidences of basification prior to granitisation. Successive stages of metamorphism and basification are recognisable. The intertrappean and other sediments associated with the metaandesites consist mainly of laminated shales, siltstones and grits which are usually well bedded and the intensity of metamorphism shown by them varies irrespective of their distances from the granite. Irregular pods, patches and tongues of granite have replaced the metamorphosed grits leaving the bedding practically undisturbed. In irregular patches and areas irrespective of sedimentary structures the metamorphosed grits or quartzites are enriched in mafic minerals such as amphibole and biotite, and adjacent to granite this enrichment is more apparent. The relict inclusions within the granitic pods and patches are further basified and consist mainly of amphibole and biotite, the former mineral being usually predominant. It is quite likely that part of the basic material removed from the zone of granitisation of the metaandesites has been irregularly fixed in the adjoining intertrappean sediments and during granitisation of the latter the basification of the relicts has been considerably enhanced. It is quite apparent from the field and microscopical evidence that the basification has been followed by granitisation both in space and in time.

#### 54. Petrology and Morphology of the Deccan Trap flows around Kolhapur (Bombay State).

R. V. JOSHI and L. S. BHAT, Dharwar.

Several trap flows were noticed in a survey of the hills locally known as Wagjaiy, Tumzai, Bavda and Panhala, near Kolhapur. These can be grouped as—

- (i) Ash-coloured or purple coloured flows. Often amygdaloidal and of friable nature (sp. gr. 1'88—2'5).
- (ii) Dark coloured hard trap, mostly porphyritic basalt (sp. gr. 2'74—2'9).
- (iii) Basalt with columnar jointings (sp. gr. 2'8—2'97 or 3'0).

Though the same set of flows is not repeated in the above mentioned hills, there is much similarity between these hills as far as their morphological aspects such as concordance of heights, slope values, and weathering characteristics are concerned. This is due to the presence of certain Deccan Trap flows which have identical physical and petrological properties.

#### 56. Variation in Bundelkhand Gneiss.

R. C. MISRA and M. N. SAXENA, Lucknow.

In Indian literature, the Bundelkhand gneiss has been repeatedly described as a gneiss possessing the characters of coarse pink granite of constant composition and almost free from accessory minerals with obscurely developed foliation.

The entire massif occupying an area of 10,000 square miles is supposed to be a homogeneous mass of pink granite showing no variations.

Our detailed study of these rocks in the districts of Haripur and Jhansi, however, has brought to light numerous xenolithic masses of rocks like quartzites, schists (micaceous and hornblende), phyllites, amphibolites etc., which grade into various types of migmatites, showing marked variations. We can divide the granitic rocks into two broad groups, viz., migmatites and homogeneous (mostly pink) granites. The migmatites show extreme variation depending upon the nature of the parent material which has been granitised. On the basis of their mineralogical characters, we have been able to identify streaky biotite gneiss, biotite hornblende oligoclase gneiss, leucocratic garnetiferous gneiss, granodiorite, granite, syenite, quartz syenite and hornblende biotite syenite.

#### 57. Sedimentary Structures in the Panchet Stage, S.-E. of Raniganj Basin.

MILAN KUMAR SEN, Calcutta.

In this area (Raniganj Coalfield Map No. 14), the following primary sedimentary features (non-diastrophic structures) in the Panchet stage were impressed on the sediments prior to their lithification.

- I. Clay Pellets—Flattened, compact, discoidal pellets (micaceous or arenaceous) of greenish to brownish shaly matter occur in the sandstone especially in the basal Panchet. The longest diameter and the thickness of the pellets usually vary from 0.25" to 1.9" and 0.1" to 1.35" respectively. Probably the same clayey material as happened to form the Raniganj shales contributed to the development of these pellets. They may have also originated through penecontemporaneous erosion of Panchet shale etc. The pellets at least signify that :
  - (a) the sediments in which they occur owe their origin to a fluvial agency,
  - (b) the magnitude of time break in between periods of deposition of the Raniganj and Panchet sediments was probably very small.
- II. Cross-lamination—More pronounced in the Upper Panchet (shallow water conditions), tabular units being more common than lenticular ones. The upper part of the units is truncated by penecontemporaneous erosion. The upward concavity, basal asymptotic relation of the laminae and higher concentration of heavy minerals in the lower portion of foreset laminae were noted. The foreset laminae have a persistent dip, seldom exceeding 15°, towards NNE-NE suggesting the flow of water into the basin from SSW-SW.

#### 58. On some sedimentological aspects of Hooghly river clay.

A. GOSWAMI and S. P. DAS GUPTA, Calcutta.

Four samples of clay have been collected at regular intervals from the western bank of the river Hooghly at Bally, Howrah district, West Bengal. The sieve (A.S.T.M.) analysis shows the following size fractions:—coarser fractions between 0.297 mm. to 0.44 mm. (39.64% approx.) and finer (about 60.38%) below 0.44 mm. in diameter. So these are mostly clay loams and silt clays.

Differential thermal curves of these two fractions suggest the presence of hydrated iron oxide, illite and montmorillonite. Under the microscope, muscovite, biotite, limonitic stains etc. could be identified.

Mineralogical composition of the samples suggests diagenetic process of formation of clay minerals.



# 59. Petrology of the Argillaceous and Arenaceous Metamorphites, near Mejia, Bankura District, West Bengal.

MILAN KUMAR SEN, Calcutta.

The type assemblages of the argillites near Mejia ( $23^{\circ}34'N$ :  $87^{\circ}7'E$ ) are:

- I. Sillimanite —Almandine —Quartz —K Feldspar
- II. Sillimanite —Almandine —Quartz —K Feldspar —(biotite)
- III. Sillimanite —Biotite —Quartz —K Feldspar —(garnet)
- IV. K Feldspar —Biotite —Quartz —Sillimanite —(muscovite),

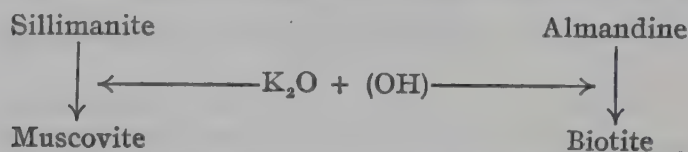
and of the arenaceous metamorphites are:—

- I. Quartz —(garnet)
- II. Quartz —(muscovite)

The study of metamorphism, ultrametamorphism and granitisation of the above members reveals that first they were metamorphosed to a very high degree-granulite facies along with the metamorphites of the surrounding country rocks. Subsequent granitisation lowered these assemblages successively through sillimanite—almandine sub-facies to cordierite—anthophyllite sub-facies, both of the amphibolite facies. This successive retrogression due to granitisation is the most important aspect of the metamorphism, the final result being the production of granite-gneiss which is a migmatite—ultramigmatite end product of slightly post-kinematic granitisation of these rocks.

The most characteristic mineral assemblage I above of the argillites is rich in 'alumina' which, together with other factors, suggests its derivation by the metamorphism of argillaceous sediment, resembling to a certain extent similar group of rocks like Khondalites, and others in Singhbhum. The more arenaceous portions gave rise to arenaceous metamorphites.

The trends in mineralogical changes in these rocks are as follows:—



The textural change during granitisation is the gradual shattering of sillimanite needles with concomitant increase in the proportion of microcline.

# 60. Petrology of the Metamorphosed Basic and Ultrabasic Igneous Rocks of the area north of Birmitrapur, Sundargarh District, Orissa.

S. P. DAS GUPTA, Calcutta.

Basic and ultrabasic igneous rocks of the area north of Birmitrapur ( $22^{\circ}24'$ :  $88^{\circ}44'$ ), occur usually as sills and rarely as dykes, in the sedimentary metamorphites of all types. Thick exposures often show fine grained (probably relict chilled) margins and coarse centre. The schistosity, which is pronounced at the margin, becomes feeble towards the centre.

The rocks of the area are polymetamorphic and the grade of metamorphism of the intrusive rocks corresponds with that of the associated sedimentary metamorphites and shows a general increase towards northeast and southwest of the area, though there is an irregularity in the distribution of the metamorphic assemblages. In order of the increasing metamorphic intensity, the following assemblages have developed:

- (a) Actinolite-albite-epidote-chlorite.
- (b) Hornblende-oligoclase-biotite-chlorite (with or without).
- (c) Hornblende-oligoclase-biotite-zoisite-sphene.
- (d) Hornblende-acid andesine-biotite-zoisite-sphene.

The quartz and ilmenite are constantly present in the above assemblages while, kyanite, tourmaline etc. occasionally occur. The pleochroism of hornblende along *c* varies from pale bluish green to dark bluish green and R.I. gradually increases with the increase in grade of metamorphism.

The ultrabasic differentiate shows the following assemblages:

(e) Talc-tremolite-magnetite.

(f) Actinolitic tremolite-albite-magnetite.

The assemblages (a), (e) and (f) noted above may be referred to biotite-chlorite facies of the green-schist facies of Eskola and the assemblages (b) and (c) may be assigned to the lower and upper part of albite-epidote-amphibolite facies respectively while the lower part of the amphibolite facies is represented by the assemblage (d).

## On the Archaean formations of Ambikapur, Surguja District, M.P.

KRISHNA KANT SINGH, Kharagpur.

The area around Ambikapur (Lat.  $23^{\circ}7'$ —Long.  $83^{\circ}12'$ ) occupying sixty sq. miles in extent has been geologically mapped. The geological formations of the area belong to the Archaeans and the Gondwanas.

The Archaeans in this area occur in two regions separated by the lowly dipping Gondwanas. In the south western region, the Archaeans consist of older metamorphites made up of micaceous schists and granitic gneisses. In the eastern part, younger sub-metamorphites consisting of phyllites, slates, argillites, quartzites, and schistose felspathic grits are exposed. In them, orthoamphibolites occur in sills showing variation in the grade of metamorphism, and mineral fabric and assemblage. An elongate granitic mass has been observed intruding into the sub-metamorphites on its western margin. The sequence of rocks in this area has been correlated with the various Archaean members of Singhbhum district, Bihar. In the older metamorphites, the sub-metamorphites and the granites are equivalent to the older metamorphics (Lower Dharwar), the Iron Ore Series (Middle to Upper Dharwar) and the Granites (Post Dharwar) of Singhbhum respectively.

## 2. On the Calc-Magnesian Metamorphites and related Amphibolites, around Kusthalia, Bankura District, West Bengal.

MILAN KUMAR SEN, Calcutta.

The calc.-magnesian metamorphites, around Kusthalia (Topo. Sheet No. 73<sup>M</sup>/<sub>3</sub>), occur as impersistent bands of varying thickness in granite-gneisses and ultrametamorphites. The diopside-calcite-granulites often pass laterally into hypersthene-diopside granulites and these are again intimately associated with amphibolites, often showing lateral transition of one type into the other.

The important constituents of the calc-silicates are diopside-hedenbergite ( $\text{Di}_{20}\text{Hed}_{80}$  to  $\text{Di}_{70}\text{Hed}_{30}$ ;  $Z \wedge c38^{\circ}$  to  $47^{\circ}$ ;  $2V$   $59^{\circ}30'$  to  $61^{\circ}$ ), plagioclase ( $\text{An}_{42}$  to  $\text{An}_{55}$ ), garnet, epidote-zoisite, calcite, sphene, scapolite, apatite, quartz and sometimes microcline. Hornblende ( $Z \wedge c23^{\circ}$ ), which is but an accessory in the above assemblages, gradually attains importance as the chief constituent of the amphibolite.

In close proximity to granite-gneiss, the calc-silicates show development of chloritoid, scapolite, sphene, epidote-zoisite, apatite etc., while the granite-gneiss, at contact with amphibolites, is characterised by a remarkable concentration of biotite. The facies of different assemblages shows more or less disequilibrium. The members were first metamorphosed to a very high degree and finally as a culmination to the process, they suffered extensive granitisation with a successive lowering of phases.



The nature of association of amphibolites, diopside-granulites, and hypersthene diopside-granulite, and the variation in composition of individual minerals in diopside suggests a difference in the composition of the original sediment from which they were derived. The portions comparatively rich in  $Al_2O_3$  (and also  $FeO$ ) yielded hornblende and possibly the portions comparatively rich in  $Fe$  and  $(Fe, Mn)$  over  $Ca$  gave rise to hypersthene.

**63. Radioactivity of the Basic Igneous Rocks of the Bijawar period and the Question of their Age by Helium Method and its Bearing on the age of the Delhi and the Vindhyan.**

V. S. DUBEY, Banaras.

Radioactive determination has been carried out on 20 specimens of the basic igneous rocks of the Bijawar age, from different outcrops in Northern India beginning in the west from Barwah near Indore up to Singhbhum in the east. The values of U content in these rocks vary from  $0.90 \times 10^{-6}$  gm./gm. to  $1.20 \times 10^{-6}$  gm./gm., the average value being  $1.10 \times 10^{-6}$  gm./gm. The He determination on some of these basic igneous rocks yielded an age somewhere between 170 and 250 mill. years. Assuming an He index on Trap rocks as 50% the true value of the age, the real age of these late Bijawar basic igneous rocks will be somewhere between 450 and 500 mill. years, which gives them an early Cambrian or even of pre-Cambrian age. The age of post-Delhi Erinpura from Bisaundi Uranite, determined by Prof. A. Holmes on a very good specimen is 740 mill. years. Thus the Bijawar sedimentation cycle is later than that of the Delhi and followed the intrusion of the Erinpura Granite. On this basis the Delhi sedimentation will be from a period somewhere between 1000 and 750 mill. years and that of the Bijawar sedimentation from 700 and 500 mill. years. The Vindhyan sedimentation followed the Bijawar sedimentation. Therefore its period can be assumed to be somewhere between 450 and 300 mill. years.

**64. Petrography of the basic doleritic intrusives in the Chittorgarh area.**

D. A. BHAGWATWAR, Udaipur.

The paper deals with the Petrography of the basic intrusives in the Chittorgarh area, Rajasthan. The object of this paper is to put on record facts which may be useful in the solution of this somewhat elusive problem of the composition of the original magma. Detailed work is in progress. Discussion of the various theories and the interpretation as regards the petrogenesis will form a separate paper. The occurrence of hypersthene and myrmekite and the peculiar relationship between the pyroxene and the plagioclases cannot be explained satisfactorily with the help of the present conceptions. Something new will have to be evolved from the present data.

**65. The Gabbro Rocks around Jeria Dungri, Saraikela, Singhbhum District.**

D. N. OJHA, Patna.

The occurrence of a large area of gabbro rocks around Jeria Dungri ( $22^{\circ}40'N$   $86^{\circ}05'E$ ) in the Singhbhum District has been reported by Dunn and Dey (1942). They occur within the Singhbhum Granite and have been cut by a number of dykes of Newer Dolerite.

Detailed petrographic studies of these rocks show that they are olivine hypersthene-gabbros with a typical ophitic texture. They form laccolithic, boss-like or dike-like bodies which hardly show any sign of regional metamorphism; rather they have suffered much alteration due to the action of hydrothermal

ions. These changes are of the nature of final consolidation phenomenon. The ferro-magnesian minerals, olivine and pyroxene show very interesting textures which have not been recorded previously. In many sections, olivine is rimmed by pyroxene suggesting that the two crystallized simultaneously. Pyroxene is found to be of the lamellar variety of Bushveld type and in some sections, relics of clinopyroxene are found enclosed in a single crystal of inverted orthopyroxene. The magnetite is of two generations. It has replaced some of the earlier formed pyroxene and feldspar.

These gabbros are very similar, in their mode of occurrences and petrographic characters to the gabbro rocks of Mayurbhanj state and as such probably belong to the same suite. The presence of striped pyroxene, lack of metamorphic characters and absence of any intrusive contact with the granite, strongly suggests that they belong to a younger age.

#### **A Note on the Geology and Petrology of some Newer Dolerite and Olivine Gabbro near Haludpukhur, Singhbhum District, Bihar.**

T. M. MAHADEVAN, Calcutta.

Studies on the alteration and shearing undergone by the Newer dolerites and Haludpukhur and the gabbro mass forming the Jheria Dungri hill about 10 miles N. W. of Haludpukhur, suggest that shearing stresses influenced the petrological transformations in these dykes to a great extent. From an examination of the possible periods of shearing, it is suggested that the shearing took place probably during the waning stages of the Iron-Ore Series orogeny.

#### **Eurite dykes in the metamorphics around Jharia coalfield.**

Y. K. AGARWAL, Dhanbad.

This paper records the occurrence of two separate eurite dykes among the crystalline gneissic rocks of the Jharia Coalfield. One of them occurs at the northern boundary, about 3 miles from Tetulmari Ry. Station (Ry.) near the junction of Sijua-Rajganj and Katras-Rajganj roads and the other at the southern boundary of the coalfield, about  $\frac{1}{2}$  mile north of Pathardih Ry. Station (Ry.). These dykes traverse the felspathic gneisses. The pure eurite is a greenish grey, compact, aphanitic rock with a conchoidal fracture and breaks with conchoidal fracture. Under the microscope it reveals only microcrystalline aggregate of quartz and feldspar with occasional veinlets of the former. Patches of coarse grained granitic material in relatively less pure rock give a glomeroporphyritic texture to the rock. These dykes are similar in mineral composition and texture to those of Giridih Coalfield described by Holland and Saise (1895) and recently by Agrawal and Subrahmanyam (1949).

Detailed mapping of the metamorphics around Jharia Coalfield may reveal the occurrence of more dykes of this nature in this coalfield.

#### **Radioactivity of Mt. Girnar Rocks and the Distribution of the Radioactivity on Differentiation.**

V. S. DUBEY, Banaras.

The radioactivity of the rocks of Mt. Girnar, a classical example of differentiation, has been determined. The rocks of Mt. Girnar can be divided into three groups. The first group belongs to the Deccan Traps, in which the gabbroidal magma intruded. The U content of a few of these rocks is roughly  $0.9 \times 10^{-6}$ .



gm./gm. Tuffs (amygdaloidal basalts) as usual gave lower value, while basalt contact with an acid rock gave a higher value of  $U\ 1.44 \times 10^{-6}$  gm./gm. The second group represents the differentiates from the gabbroidal magma. The content in these differentiates is as follows:

1. Magnetite	...	...	...	$0.20 \times 10^{-6}$ gm./gm.
2. Olivine gabbro	...	...	...	$0.45 \times 10^{-6}$ „
3. Gabbro	...	...	...	$1.7 \times 10^{-6}$ „
4. Mala-diorite	...	...	...	$3.20 \times 10^{-6}$ „
5. Nepheline syenite	...	...	...	$3.12 \times 10^{-6}$ „
6. Lamprophyre	...	...	...	$3.45$ to $3.65 \times 10^{-6}$ gm./gm.

After these differentiates there came the acid intrusions. The U content microgranites of the third group is about  $3.3 \times 10^{-6}$  gm./gm., while the effusive rocks represented by obsidian rhyolite gave a value of U content as  $4.4 \times 10^{-6}$  gm./gm. and  $4.10 \times 10^{-6}$  gm./gm. respectively. These values are very similar to other granites. It appears that on differentiation the U content rises and on reaching the stage of Nepheline syenite it attains the same value as that of granite. The second important point is that, in the last stage of differentiation when the magma separated into two parts giving rise to Nepheline syenite and lamprophyre, the U contents in both these rocks remained almost constant, in spite of the fact that one of these rocks is very rich in feldspathic minerals while the other is rich in ferro-magnesian minerals. Therefore it can be concluded that the U content does not vary according to the group of minerals but remains uniformly distributed.

#### 69. Radioactivity of the Deccan Traps.

V. S. DUBEY, Banaras.

The Uranium and Thorium contents of a large number of specimens of Deccan Traps from Bhor Ghat and Thal Ghat tunnels, from Koyana Project and from Helwak-Chiplon road (Bombay State) have been determined. The Ur was determined by the Fluorimetric Method, while as a check Radium was also determined by Fusion. The total radioactivity was found by Alpha-Count Method. The examined specimen consisted of true basalts as well as ash-beds. For majority of the true basalts the Ur content ranged from  $0.9 \times 10^{-6}$  to  $1.20 \times 10^{-6}$  gm./gm. The Ur content of ash-beds ranged from  $0.60 \times 10^{-6}$  to  $0.90 \times 10^{-6}$  gm./gm. and was less than the true basalts, proving that some Ur was lost during the formation of the ash-beds. The Th content varied between  $2 \times 10^{-6}$  and  $3 \times 10^{-6}$  gm./gm. In case of the true basalt, the average content of eight specimens was,  $2.80 \times 10^{-6}$  gm./gm. The ratio Th/Ur ranged between 2 and 3, the average being 2.5, though some ash-beds gave ratios between 4 and 6, proving that relative to Ur much Th was lost in the process of formation of the ash-beds.

#### 70. A Tectonic Analysis of the Quartz Reefs in the Metamorphites of Tilat Tetulmari (Dhanbad).

M. S. SADASHIVAIAH, Dhanbad.

Numerous quartz filled faults occur in the metamorphites comprising of micaschists, granulites, injection gneisses, migmatites, amphibolites and hornblende gneisses of Dharwar age in the Tilatanr area. Metamorphites have been folded into a pitching anticline with drag folds on its limbs due to strong folding movements and deformation during Dharwar period. Quartz filled faults occur not only

is individual ones but also as zones. Various structures have been noticed in the quartz of the quartz filled faults namely, boxworks, honeycomb texture, platy quartz, shear fractures, tension joints and joint drags. Faults are later than folds and hence they are incongruous with the fold. On tectonic analysis it has been found that there are two types of faults namely high angle shear thrusts (reverse faults) and normal faults. Normal faults are later than the shear thrusts and they represent latest adjustment of rocks to deformation. Shear thrusts are parallel to the strike of the beds and the regional structure and they are reverse faults. Associated with the shear thrusts occur shear fractures, tension joints and joint drags. These minor structures associated with the shear thrusts have been analysed and their relation to structural axes have been described on the lines of Sander, Cloos and others.

**71. A Note on the origin of Cordierite-bearing and other Vitrophyric and Hornfelsic rocks of Chasnala area, Jharia Coalfield.**

M. S. SADASHIVAIAH AND Y. K. AGRAWAL, Dhanbad.

Cordierite-bearing vitrophyric rocks are found to occur as in situ bouldery outcrops about one furlong to the west of Chasnala Colliery, adjacent to a thin sill of mica peridotite. Occurrence of burnt shale due to outcrop coalfire of seam number XIV over a length of approximately  $\frac{3}{4}$  of a mile has also been found in the area. Cordierite-bearing vitrophyric rocks and burnt shales are found side by side along the same strike. Both the types of rocks have been described in this paper in detail. The burnt shales due to outcrop coalfire do not contain cordierite or allied minerals found in the vitrophyric rocks. From the mineralogical composition it is suggested that the cordierite-bearing rocks are rich in  $\text{Al}_2\text{O}_3$ ,  $\text{CaO}$ , and  $\text{MgO}$ , while the burnt shales have the composition of a normal pelitic sediment. Various controversial views on the origin of cordierite-bearing vitrophyric rocks have been discussed in the paper. The absence of cordierite and allied minerals in the burnt shales of this area clearly indicates that the origin of cordierite-bearing vitrophyric rocks in this locality at least is due to the metasomatism of mica-peridotite and shales as suggested by Sharma and others (1950).

**72. A Preliminary Note on the Dykes of Hirapur-Narwa area in Saugor District, Madhya Pradesh.**

G. W. CHIPLONKAR, P. N. JAGATAP, AND B. R. PATEL, Saugor.

The dykes traversing the Bundelkhand gneiss in the Hirapur-Narwa area are of epidiorite, uralite gabbro and quartz diorite. Their general direction is E.N.E.-W.S.W. to E-W.

The vortex texture and ragged edges with corroded borders shown by the feldspars and uralitic hornblende, as also the presence of the mineral assemblage such as of chlorite, epidote, uralitic hornblende, albite and sphene and sometimes also biotite, show that these dykes have suffered regional metamorphism of the chlorite-biotite stage.

The persistent presence of clouding of plagioclase in the epidiorite dykes and definite absence of such clouding in the other dykes which occur in their close proximity, shows that the dykes intrusive into the Bundelkhand gneiss of this area are of two groups, the epidiorite dykes being the older one. The gabbro and diorite dykes appear to be responsible for the regional metamorphism which has brought about the clouding of the plagioclase feldspars of the epidiorite dykes.



**73. A study of the Granites of Jabalpur (Madhya Pradesh).**

S. N. WAKHALOO, Patna.

The paper relates to the granite and allied rocks outcropping in and around Jabalpur, Madhya Pradesh. On the basis of studies in field and laboratory three varieties of granite have been distinguished: (i) the coarse grained porphyritic granite with a colour index of 5; (ii) a medium grained gneissose granite with a colour index of 33 and (iii) a fine grained variety comparable to microgranite. The rocks with a high colour index bear abundant accessories especially apatite and allanite. From a comparative study of these different kinds of rocks it appears that the coarse grained variety permits of no other interpretation than that it is of magmatic origin. The rocks of the second and third variety, however display such characters as to warrant an interpretation of origin from metamorphic rocks. The field evidence consists of a complete gradation from original country rock of sericite schist (the relics of which are found at many places in the region) to completely granitised rocks. Textural and structural evidences leading to the conclusions have been discussed.

**(v) Economic Geology****74. On the emplacement of Chromite in Quartzite near Ghotringa, Dhenkanal district.**

M. N. DEEKSHITULU, Calcutta.

An interesting occurrence of chromite in quartzite is noticed N. E. of Ghotringa ( $21^{\circ}7' : 85^{\circ}35'$ ), where the quartzites show a swerve in their attitude from almost N.S. to N.W.—S.E. Though peridotitic rocks are seen about a mile away further north-west, these banded quartz-chromite rocks are separated from them by bands of pure quartzite.

The chromite is generally fine-grained and glassy, though occasionally crystalline, and occurs as stringers and veins in the quartzites, occupying their bedding planes as also the interstitial spaces between the quartz grains. Sometimes it throws tongues into quartz, or engulfs pieces of brecciated quartzite, thus indicating its having been intruded in a liquid state. The veins of chromite are remarkably free from any silicate matter; even in thicker veins the subhedral crystals of chromite are separated only by finer chromite. These features point to a pure chromite melt having separated from the parent magma at depths and its later intrusion, along with the earlier formed crystals, into the quartzite. Diffusion of chromite into quartz is indicated by the clouding exhibited by some of the engulfed pieces of quartz particularly with great intensity nearer chromite.

Undulose extinction shown by quartz is indicative of high stress and the absence of any evidence of its remelting shows that the temperature of the chromite melt was rather low.

Development of chrome mica (fuchsite), chrome chlorite (kammererite) and chrome epidote (tawmawite) is noticed at the contact of the quartzite and chromite.

**75. Mineral matters in Coal and a Technique for their removal.**

D. LAHIRI, Calcutta.

Coals impregnated with finely disseminated mineral matters are not amenable to successful cleaning by Float and Sink Method in mixtures of Benzene and

Carbon Tetrachloride. Such coal can be beneficiated to a large extent by an improved technique of cleaning. The method consists of grinding of properly sized coal (14 mesh) in a ball mill continuously, having mixed with a hydrocarbon oil and water. The fine mineral matters of the coal get released and make the water muddy. By repeated washing these are removed. Beneficiated coal remains as coal-oil paste and coal is made free of oil by treating it with a suitable solvent like Benzene and Carbon Tetrachloride.

The author could reduce the ash percentage of a specimen of coal to 11.1% from original 22.1% by grinding for a total period of 42 hours.

#### 76. On the Manganese ore deposits of Jamda Valley, Keonjhar.

SUPRIYA ROY, Calcutta.

The results of the investigation carried out on the manganese ore deposits of Jamda Valley (topo sheet No. 73 F/8) are given. Manganese ore occurs in phyllites, cherts and cherty quartzites of the Iron Ore Series in the form of replacement deposits. It is also associated with the dolomite and iron ores. To review the quality of the manganese ore deposits the area has been divided into three zones :

Northern Zone (Deposits around Naida— $22^{\circ}9' N$  &  $85^{\circ}24' E$ ) :—Satisfies the specification of (Cie Belge) Mn.—48.38%, Silica—2.43-4.44%, Iron—10.31-14.92% and Phosphorous—0.061-0.105%.

Southern Zone (South of Barabil to north of Joda) :—Deposit just south of Barabil—Mn. up to 45%, generally between 30-45% and Fe. up to 20%.

Thakurani Deposit—Mn. up to 48%, Fe. up to 20%, P—0.05-0.1%,  $SiO_2$ —3-5%.

Deposit Spencer— $MnO_2$  up to 90-95%, Fe. up to 4%, Silica up to 3% and Phosphorous up to 0.2%.

Western Zone (West of the Karo river) :—Manganese up to 51% has been estimated.

Manganese minerals identified under the ore microscope are Psilomelane, Pyrolusite, Polianite, Manganite, Romanechite. The original mineral is Psilomelane brought in as colloidal floculates. Absence of syngenetic manganese silicate minerals suggests that the deposits escaped serious thermal or regional metamorphism.

#### 77. A note on the occurrence of Galena near Beldih, Manbhum district, Bihar.

SUNIL KUMAR CHATTERJEE, Calcutta.

Galena was found associated with low grade metamorphites near Beldih ( $23^{\circ}03' : 86^{\circ}18' E$ , 73 I/8). The metamorphites are mostly low grade argillaceous and arenaceous phyllites and schists that show intense brecciation, concomitant recrystallisation, and large scale silicification. The galena occurs in vein part of which had been worked out. The concentration nowhere is very great. The mineral is intimately associated with quartz. Association of galena also in the brecciated cavities suggest that it might be genetically related to brecciation. Under the ore microscope galena and pyrite were noticed. The texture is coarse grained xenomorphic.

#### 78. Ore-microscopic study of the Lead-Zinc-Silver ores of Zawar Mines, Rajasthan.

BANKIM MUKHERJEE AND SUPRIYA ROY, Calcutta.

Polished sections of the Lead-Zinc-Silver Ores of Zawar mines, Rajasthan were studied under reflected light and the following minerals were identified : Galena, Sphalerite, Jamesonite, Alaskaite (?) and Pyrite. The reflecting power for each



of the minerals was determined by Berek's Slit Micro-photometer in green light in air with the following results: Galena—43, Sphalerite—18, Pyrite—54. The reflectance of Jamesonite could not be measured as the grains were too small.

Galena and sphalerite are present in more or less equal proportions in the sections examined. Jamesonite is scattered in minute grains in the sphalerite, whereas Alaskaite occurs as inclusions in galena. Definite replacement relation has been encountered between Galena and Sphalerite, the former in all cases replacing the latter.

#### 79. A Note on China Clay Deposits near Khanapur, Belgaum District.

Y. S. SAHASRABUDHE, Calcutta.

The note embodies the results of the investigation of china clay deposits in the Khanapur *taluk*, Belgaum district. The rock formations in the area consist of an elliptical mass of granite-gneiss with bands of Dharwarian schists on either flank. They are unconformably overlain by Deccan traps towards the north. The prominent china clay deposits occur mainly towards the east, south and south-east of Khanapur, and are of primary type resulting from the alteration of felspar in the granite-gneiss.

The origin of china clay and the agencies influencing kaolinisation have been discussed. Probable indications which may help in further prospecting the clay have been mentioned.

About 17 deposits are described, and the results of physical tests of the samples are incorporated. In general, the clay is white, fairly plastic and turns grey on firing. It does not fuse at about 1400°C., and its linear shrinkage is within acceptable limits. It is contaminated with a little iron and is somewhat gritty. Suggestions to exploit the deposits economically have been indicated.

#### 80. On the occurrence and beneficiation of Coal from the West Bokaro Coalfield, Hazaribagh District, Bihar.

A. GOSWAMI, Calcutta.

Two coal seams occur with the Barakar sandstones and shales near Datma ( $23^{\circ} 44' : 85^{\circ} 27' 40''$ ) and Hesagora ( $23^{\circ} 45' 30'' : 85^{\circ} 30' 30''$ ) 31 and 24 feet thick respectively. These coals are highly caking (index: 11/15 and 6/10), with low moisture (2 & 3%), rather high volatile matter (24 & 30%) and 16%—25% ash. On washing them with Benzene-Carbon tetrachloride (sp. gr. 1.45), the improvement is apparent from the analysis of the float portions (75-91%):—V.M. 31-33%, Ash 9 & 11% and caking index 16/20 and 11/15 respectively.

Five new outcrops of coal (5'-8' thick) occur in the same formation in the Bahera *nala*. These are, however, non-caking, with high ash (26-29%) and high volatiles (30-31%), which on washing with the same liquid have the ash reduced to 14% and the V.M. increased to 33%. The 75% float of the coal shows a C. I. below 5. Thus, the coal may be utilised for producing gaseous fuel, and the float for manufacturing synthetic petroleum. The 2 main seams have the quality of metallurgical coking coal, and may also be used in a bye-product industry, synthetic fuel and boilers.

#### 81. A Note on Bhimber Bentonite.

M. N. SEHGAL, Calcutta.

The paper describes the bentonite deposits of Bhimber occurring between  $30^{\circ} 21' 30''$  and  $32^{\circ} 56'$  latitudes and  $74^{\circ} 0'$  and  $74^{\circ} 25'$  longitudes in topo sheets No. 43 K/4, L/1 and L/5. The tests show that it is a true bentonite greyish in

our, and at times having a greenish tinge. It is compact and fine-grained with a sp. gr. of 2.406. It slakes in water and is slightly plastic. The staining and fluorescence tests indicate dominance of minerals of montmorillonite group. This has been further corroborated by differential thermal study. The mineral occurs associated with the Upper Siwalik formation. It is suggested that it has possibly been formed by the alteration of the Panjal trap ash or the tuffaceous beds.

## 2. Heavy Mineral study and Subdivision of Lower Barakars of Tisra area—Jharia Coalfield.

SUBRATA GHOSE, Dhanbad.

A detailed study of the heavy minerals of the sandstones of Tisra area, Jharia Coalfield, was taken up with a view to correlating the seams and further to see if the Lower Barakars could be subdivided on the basis of this kind of petrological work. The un-numbered seam of Fox has been correlated by the present author to a new seam, the Dumrakocha seam. The one occurring just below seam No. X has been designated as the 3rd section of seam No. X and not seam No. IX. With regard to the subdivision of the Lower Barakars it is suggested that two groups, Upper and Lower may be recognised with the intervening boundary at the bottom of seam No. VA (V of Dr. Fox) and not below VIII seam as done by Fox. This suggestion is based on the evidence of Zircon in heavy residue. Proximate coal analyses also support this view.

## 33. Iron ore deposits around Barabil, Keonjhar.

SUPRIYA ROY, Calcutta.

The results of the investigation of the iron ore deposits around Barabil, Keonjhar (Topo. Sheet No. 73 F/8), have been compiled. The deposits are scattered as concentrated pockets in the B.H.Q. of the Iron Ore series. The ores belong to the following types: Massive, Laminated, Shaly, Blue Dust or Powdery and Lateritic. The quality of the ores was determined from analysing representative samples from three selected mines.

The massive ores are original deposits. Workable iron ores have also been formed by hematitisation of the lavas, enrichment of the phyllites by the leached out iron and surface enrichment in the form of laterites.

## 84. Chromite Deposits of Maruabil, Dhenkanal district, Orissa.

M. N. DEEKSHITULU AND P. PERRAJU, Calcutta.

The paper deals with the description of the chromite deposits occurring over an area of 1.05 sq. miles, about a mile south of Maruabil ( $21^{\circ}3'$  :  $81^{\circ}43'$ ) in Dhenkanal district, Orissa. These deposits are located almost at the south-eastern end of the twenty mile long belt of chromite occurrences discovered by the senior author in 1951.

The rock formations found in the area are epidiorite, ultrabasics, chromite, granite, dolerite, quartz-vein and laterite. The ultrabasics include dunite and saxonite, which are mostly serpentinitised, and pyroxenite (enstatite). The chromite is seen emplaced in dunite and saxonite along the shear zones which seem to have governed ore deposition. Along the shear zones the rocks have been rendered schistose and the development of antigorite, talc, tremolite, magnesite and chrysotile is noticed. Chromitite, essentially comprised of chromite in a talc-



serpentine matrix, is seen at some places. The silicification and lateritisation of dunites are noticeable in the area further east and a few pockets of lateritised chromite are found associated with them.

The chromite occurs as a massive ore and as small scattered grains occasionally collected into chromite-rich streaks and bands in the serpentine. The lodes vary in size from 15 to 300 feet in length and 10 to 35 feet in width. Three generations of chromite are noticeable with the finer-grained, younger ones cutting the coarser, older ones.

The minimum total reserves, of all types of ore, are estimated at 1,20,000 tons down to a depth of 50 feet.

#### (vi) Engineering Geology and Ground Water Supply

##### 85. Study of the effects of deforestation on the intensity and frequency of rainfall and floods in Pathri, Ranipur and Ratmau Torrents.

A. P. BHATTACHARYA, Roorkee.

It is examined whether even the limited deforestation being carried out in U.P. has any undesirable effects of increased floods. The torrents taken into consideration were the Pathri, the Ranipur and the Ratmau. These are Himalayan torrents with shingly and sandy beds which join the Upper Ganga Canal near Roorkee. The width at their junction with the Upper Ganga Canal varies from 200 to 300 ft. These torrents pass over areas which are at the foothills of the Himalayas and form a part of the Siwalik range.

Correlation analyses were carried out for these catchments for a number of variates, namely, frequency and intensity of floods as well as total and monsoon rainfall, with net deforestation. It was found that the planned and limited deforestation does not have any untoward consequences for Pathri and Ranipur catchments. It was only for Ratmau that some effect was felt on the somewhat increased frequency (and not intensity) of floods. It was also found that planned deforestation in either of the catchments was not having any significant effect on rainfall, which did not exhibit any marked change in either its intensity or distribution.

##### 86. Soil, its erosion and conservation in the Sadar sub-division of Ranchi, Bihar

R. VERMA and M. PATHAK, Ranchi.

This paper deals with the types of soil found in Sadar sub-division of Ranchi, their erosion and conservation. Nature of bed-rocks, climatic conditions, organic materials, relief and drainage have played important role in the formation and development of different types of soil found in this sub-division. Six types of soil have been recognised by the authors in this sub-division. They are ;—(a) Laterite and Laterite soil, (b) Red soil, (c) Regur soil, (d) *Lal Matia*, (e) *Bala*, (f) *Nagra*, and (g) *Pankua*.

Problems of soil erosion are very acute throughout the sub-division. The entire sub-division is affected by sheet and gully erosion. The main causes of soil erosion as analysed by the authors are as follows :—

- (1) Destruction of forests,
- (2) Shifting cultivation,
- (3) Deterioration of village forests,
- (4) Deterioration of pastures,
- (5) Faulty method of cultivation.

### Probability of High Floods in the Rupnarayan, The Kansai and the Subarnarekha.

P. K. SIRCAR, Calcutta.

An analysis of a 16-year record of daily discharges of the Dwarkeswar at Knibasa Ghat shows that the probability of a flood of 73.7 thousand cusecs in any year is 1 : 7 against, while a flood of 47.4 thousand cusecs is as likely as not to be expected in a given year.

For the Kansai at Panskura the observed daily discharges above 10,000 cusecs during June to September for 31 years at 5-day intervals were plotted against the number of times that these discharges were equalled or exceeded in the 31-year period. It is easy to read off from the graph the probabilities of flood of different magnitudes.

A study of the 16-year descriptive record of floods leads us to the conclusion that a 'slight' flood can be expected once every 3 years in the Rupnarayan, once every 5 years in the Kansai, but twice in 9 years in the Subarnarekha. The probability of a 'severe' flood in the Rupnarayan and the Subarnarekha comes respectively to 4 and 5 in a century. The Kansai has not recorded any 'severe' flood in that period.

### 8. Penetration of rain water to ground water table in Doabs west of the Ganga River.

A. P. BHATTACHARYA, Roorkee.

A study of the dynamic equilibrium of the ground water table has been carried out for five doabs west of the Ganga River in western U.P. based on quantitative methods. As the ground water equation contains terms which can be determined only by very costly experiments, a simplified ground water equation is evolved for quantitative study of ground water resources and this can only be approximate.

If  $S$  = average specific yield of the formation,

$V$  = volume of ground unwatered,

$V \times S$  = change in storage,

$W = I + R$

= water supply received from inflow,  $I$  and rainfall,  $R$ ,

and  $P$  = total water pumped during a year,

then  $W = V \times S = I + R = P$ .

Based on the above equation, values of penetration of rain water to ground water table were worked out for each Doab from 1937-38 to 1952-53. The following relationship was worked out :—

$R_p = 5/3 (R - 14)^{2/5}$ , where  $R_p$  is the penetration and  $R$  the precipitation in inches.

### 89. Geology of the ground water relations, revealed from the bore-hole records at the Contai Sea Coast of West Bengal.

S. DEB, Calcutta.

The relation between the sub-surface sweet water and saline water has been established in this region by detailed bore-hole studies.

The Ghyben-Herzberg theory about the relation of fresh water to salt water at a depth near the sea coast, has been verified experimentally by sinking several bore-holes and also by heavy and continuous pumping of the wells put into the bore-holes. About 400 feet deep wells have been sunk in several localities along the coast line of Contai, from Digba in the west upto Samudrapur towards the east.



The salinity of the tube-well water and the yield have been recorded at different depths by putting suitable strainers in different percolating strata at varying depths.

The results have been tabulated systematically and a conclusion has been drawn as to the exact application of the Ghyben-Herzberg theory to the experimental results.

It has been found that due to the shallow nature of the sea in this region, the salinity of the deep-seated ground water does not exceed the salinity of the sea water in different seasons of the year. The bore-hole observations recorded were quite different in different localities of the sea coast, as revealed by deep borings made in order to locate the source of pit-brine.

## B. GEOGRAPHY

### (i) Physical Basis of Geography and Geomorphology

#### 90. Some Glacial Lakes of the Pir Panjal Range.

H. L. CHHIBBER, Banaras.

The crest of the Pir Panjal Range constitutes the boundary between the Baramula district of Kashmir and the Poonch State. The range has practically north-south but somewhat zig zag strike. The heights in the north exceed 14,000 feet above the sea level but in the extreme south they exceed 15,000 feet above the sea level, the maximum being 15,560 feet above the sea level.

A very noteworthy feature of the area, which is mainly represented on map sheet 43 K/5, is that a number of glacial lakes occur on the eastern side of the range. The northernmost is marked Damam Sar and a stream flowing from it forms the headwaters of the Oadatar Nala. To the south three lake basins connected by another headwater of the above Nala occur. Farther south occurs the Bod Sar which is more than  $\frac{3}{5}$ th of a mile in length and two-fifths of a mile in breadth. At the head a partial amphitheatre or corrie is observed. The lowest point of the lake is marked 13,043 feet above the sea level. Tiny lake basins occur lower down also. Towards the south another two lake basins occur connected by a stream which forms another interlinked headwater of the Bod Sar Nala. The upper one is about  $\frac{1}{2}$  a mile in length, while the lower one measures  $\frac{3}{10}$ th of a mile in length.

A little farther south lies Pam Sar which measures  $\frac{7}{10}$ th of a mile in length and about  $\frac{1}{5}$ th of a mile in breadth. It has a north-south extension and the uppermost point is marked 13,152 feet above the sea level and the point where the stream emerges from the lake is 12,650 feet above the sea level. This lake forms the headwater of the Sinwar Nala, while tiny lake basins occur down to 12,200 feet above the sea level. At least eight lake basins occur in a distance of less than 4 miles in north-south direction, but on the western slopes of the range such large lakes are conspicuous by their absence although a small glacier occurs on the west and a few small lake basins.

It definitely proves that at one time glaciers were common on the eastern slopes and although they have disappeared, their work in the form of the lake basins at this altitude is to be observed. In the south, however, glaciers occur on both sides, south of point 14,769. The present glaciers on the east descend to 13,400 feet above the sea level; but undoubted rock basins extend to 12,100 feet above the sea level.

Another noteworthy point is that no forests occur on the east, while on the west coniferous forests extend up to an altitude of about 10,500 feet above the

a level. Permanent settlements occur in the valleys and on the slopes up to a height of some distance below 8,000 feet above the sea level.

### 1. Radial Drainage of the Mikir Hills, Assam.

H. L. CHHIBBER, Banaras.

Mikir Hills in the west of the Sibsagar district in Assam reveal an interesting pattern of radial drainage. These hills occur to the south of the Brahmaputra river, and are mainly represented on map-sheet 83 F. From north-south they nearly occupy a distance of about 40 miles, while from east to west their breadth exceeds 45 miles. The highest point, more towards the south, is a trigonometrical station 4,472 ft. above the sea level. The streams flowing to the north are the Deopani Nala, Diphlu Nala etc. It appears that the streams in the plain of the Brahmaputra have been migrating as there is the Mara (dead) Dhansiri Nala flowing to the south of the Dhansiri River. Likewise there is the Mara Diphlu Nala flowing to the south of the Diphlu Nala. It appears therefore that the drift or the migration in this case has been to the north as the Mara or the dead streams now lie to the south. It is also noteworthy that the Dhansiri river and the Diphlu Nala on emerging from the south flow to the west for considerable distance parallel to the Brahmaputra before joining it showing thereby that these streams in their plain course furnish another example of their westerly drift.

The streams rising from this massif and flowing to the east are the Deubir and Deuri Nalas which are tributaries of the Kaliani river which on emerging into the plain follows a northerly course until it joins the Dhansiri river. Another stream joining the Kaliani about the middle of the massif is the Janghanri Nala flowing from the south while the Tarapung Nala joins it from the north. Next are the Daiguring River, Nambār Nala, Deopani Nala and other streams rising in the south. These are all tributaries of the Dhansiri River.

The streams which flow to the south comprise the Dilai Nala, but the Jamuna river is important, while the other streams like the Langhit Nala with its several headwater streams are its tributaries. The same is true of Disobal Nala, Patradisa Nala, Tikok Nala, etc. Now remain the streams flowing to the west. It is noteworthy that the streams flowing to the east have been more active and by head erosion have extended their courses to the west, but there is overlapping of the drainage to the east and the west. Commencing from the south we have the Chelabor Nala, Horgati Nala and Horu Dikharu Nala. These are all tributaries of the Jamuna river, while the Deopani and Kalpani Nalas flow into the Mara Diphlu Nala in the north. Thus there is no doubt about the radial pattern of the interesting drainage of the Mikir Hills.

Waterfalls are numerous in this region ranging in elevation from 25 feet to 200 feet. Waterfalls 100 feet in height and more are quite common. In places the streams flow through deep gorges. In some places e.g., in the headwaters of Patradista Nala, etc. natural bridges occur.

### 92. Geomorphic history of the area in the Vicinity of Gaya.

BHAGWAN DASS, Kharagpur.

In the area between latitudes  $24^{\circ}45' : 24^{\circ}51'40''N$  and longitudes  $84^{\circ}56'30'' : 85^{\circ}1'20''E$ , is a transition zone of the Gangetic plain and the Chotanagpur plateau and the former is broken by the monolithic domes. The four groups of hills, providing interesting topographic types are Preysila-Brahmayoni-Ramsila and Katari hills, which are traced to be the broken spurs projecting from the Hazaribagh plateau. The preliminary form of land, resultant from the igneous activities of the Archaean era, has been sculptured through geological ages and modified



into the numerous assemblages of geomorphic forms, which are expression of the four variable factors : lithology (mineral assemblages and fabric of the different rocks), structure (joints and highly inclined beds), processes (insolation and mechanical and chemical actions of rain), and stage (full mature to old stage).

The variability in the scenery lies in the presence of granitic-, phyllitic-, quartzitic- and epidioritic topographic patterns which are discussed in great detail. The landscape is in full mature to old stage of development as indicated by : (i) Coarse to medium textured dissection of hills, (ii) Low relief and (iii) Broad, meandered and aggraded river valley of the Phalgu.

### **93. Geomorphic Features in the Sikkim hills and their Relation to the Pleistocene Ice-Age in the Eastern Himalaya.**

I  
N. R. KAR, Calcutta.

In order to find out further corroborative evidences in confirmation of a Pleistocene glaciation in the Submontane Zone of Eastern Himalayas (Proc. Ind. Scie. Cong., Vol. xxxvii, xxxviii and xl in 1950, '51 and '53) further reconnoitry studies were made in the higher hills of the Sikkim Himalayas, lying just north of the area investigated before.

The area under review comprises the eastern part of Sikkim State lying between the Tista valley in the west and Sikkim-Tibet Ridge in the east, and conveniently divided into two zones on the basis of morphology. The northern Zone A, lying between the latitude  $27^{\circ}45'$ — $28^{\circ}05'N$  and between 14,000—19,000 ft. of altitude represents a typical glacial zone manifesting a host of glacial features besides the huge glacial grounds under permanent ice. In addition, sinuous lines of lateral and terminal moraines hang down the deep, flat, U-shaped valleys with tributary valleys overhanging both sides now occupied by a waterfall. Quite a number of glacial lakes, lying at the lower reaches of present glaciers and quite large in dimension testify to the vigorous scouring action of the glaciers at the time of their maximum extension, while some lakes are purely morainic lakes dammed behind the terminal moraines.

The Zone B lying farther south between the altitude of 12,000—15,000 ft. far away from the zone of present day glaciers, represents a typical 'peri-glacial zone', showing strong evidences of past glaciation. Here sharp-edged and serrated ranges and deep U-shaped rock basins now occupied by lakes, dot the entire area, and provide the source region of the headwaters of the Tista and the Jaldhaka drainage systems. A series of lakes in a 'beaded pattern' lying along the rock-basin testify to the vigorous but differential erosion of the past glaciers during the last Pleistocene Ice-Age, which have subsequently receded back far to the north described earlier.

### **94. Characteristic features of the drainage around Dharwar (Bombay State).**

R. V. JOSHI and V. M. DEHAI-KULKARNI, Dharwar.

The drainage around Dharwar (in Sheets Nos. 48 M/3 and 48 I/15) shows trellis pattern. South of Hubli lies the main divide which separates the drainage into its two components : (1) Eastern and North-Eastern, characterised by the Benni Halla and its tributaries, having low gradients, and (2) Western, consisting of the Bedti river and its tributary (the Birtical halla) which have higher gradients.

The initial drainage was formed on the folded Dharwar formations consisting of quartzites, phyllites and shales which have NW-SE strike and high angle of dip mostly towards east. The remnants of initial consequent streams are very few and the major stream directions indicate subsequent or strike streams (viz. The

Birtical Halla, Shalmala Halla, and the northern extension of the Bedti Halla). The beds of all the streams lie on the weaker rocks—shales or weathered phyllites. The Bedti river which flows south or south-westward collects waters of the strike streams mentioned above and discharges finally into the Gangavali river on the west.

The general arrangement of the strike or dip streams (trellis pattern) is at some place disturbed by the igneous intrusions (dykes) and irregularly distributed harder bands of the Dharwar rocks.

#### 95. The Old Courses of the Bhagirathi River near Nabadwip (West Bengal).

SIVAPRASAD DAS GUPTA, Calcutta.

The paper deals with the problem of tracing the old courses of deltaic rivers in general and of the Bhagirathi in particular. Normally, retracing the old courses of a deltaic river is a complex problem. No general principle of hydrology facilitates the determination of the age of an ancient bed of a river and reconstruction of the old courses of the river. Hence some working hypotheses have been formulated. These hypotheses are based upon the normal behaviour of a deltaic river which generally exhibits a tendency towards continual change.

Apart from the normal secular changes of the courses of a deltaic river, diastrophic movements also occurred in the Bhagirathi river, bringing in further complication.

In tracing and reconstructing some of the old courses of the Bhagirathi in a few maps all these factors were considered and help of various historical records and old maps was taken to mark some fixed points of the old courses. It has been shown that in this area the course of the river, before the start of the Christian era, was about twenty miles further in the west compared to the present channel. This was a most ancient course and is now occupied by a small river, the Khari. During recent times the river slightly migrated as a whole from east to west, leaving more deserted meanders in the flood plain lying to the east of the river than to the west. There were also certain oscillatory movements. It appears also that the tortuosity of the Bhagirathi underwent changes during the recent past.

### (ii) Urban Settlements and Economic Geography

#### 96. The role of Geography in City and Regional Planning.

S. M. ALI, Aligarh.

The essence of planning is a philosophy, an approach, a way of doing things, a democratic process—rather than a series of physical design problems or beautiful master plans for which there is no adequate machinery to translate them into improved facilities or conditions for human use. A geographer having a background to analyse the community and to recognise the functional relationships between its component parts could, on this basis assist in the location or attraction of industry, expansion of trade and service and whatever else may be necessary to put the local economy on a firm and sounder basis.

Taking it from four angles, planning is based on the following broad principles :

- (i) Planning is a means to an end. The point of planning is to attain something and not merely to describe something.
- (ii) Planning must be elastic but the ends must be steadfast.
- (iii) Planning is visualising. It does not build nature. It builds upon nature.



(iv) The thing planned is movement. We plan a region not as an inert area but as a sphere of action. We plan the movement or activities going on there—especially the potential movement capable of going on there.

The contributions that geography can make to planning are many and of diverse nature. There are however, four of them which are important for planning and are of unique geographic nature.

(i) The broad regional perspective peculiar to geography.

(ii) Application of sound geographical thinking with regard to the relationships between human activities and their physical settings.

(iii) An approach which is truly scientific.

(iv) Methods of geographic investigation and presentation.

## 97. Urban Hierarchy in the Umland of Banaras.

R. L. SINGH, Banaras.

The Umland of Banaras is essentially an agricultural country. According to 1951 census only 7.2 per cent people live in towns of all sizes.

It is quite true that the importance of an urban centre is reflected in its size, particularly in respect of large towns; but in seeking more satisfactory criteria for measuring urban rank it is well to take account of essential functions of towns and the institutions discharging them. Though any grading must in some measure be arbitrary owing to the fact that the urban scale is as continuous as the social scale, yet five service institutions—Banks, secondary schools, cinemas (weekly or daily), newspapers and hospitals—may be regarded as the key criteria of what may be called a “full fledged town”. Other typical features are professions, multiple stores and administrative offices.

Taking into account both the size and service factors the following grades of urban centres can be distinguished: (i) city, (ii) sub-city, (iii) large towns and (iv) small towns or urban centres. The city is characterised by a population of over 100,000 and having a large and well defined natural and economic zone as its tributary area. The sub-city may be defined as being next to the city both demographically and functionally. The large town may be identified by a population between 20,000 and 50,000 and satisfying most of the key criteria of a town. All the towns below 20,000 may be included in the last category.

## 98. Serampore : An Urban Study of a Satellite Town, Calcutta.

A. B. CHATTERJEE AND MRS. MIRA GUHA, Calcutta.

Serampore is a town with a total population of 74,324 situated in the urban continuity of Calcutta-Howrah along the Hooghlyside. Functioning mainly as an important textile town, its history may be traced to European settlements of trade and commerce in the Hooghly region. The Hooghlyside conurbation has grown mainly with the economic background of jute and the result has been in a string of industrial concerns stretching from Bansberia to Chinsurah. In such a development of continued built-up area with an absence of any green belt, Serampore has all the characters of a satellite town in the Hooghlyside region.

A study of the functions of the city reveals the importance of industry and the mark it has left on the residential population. With its self-sufficient activity of textile industry, Serampore may easily form an important area of refugee rehabilitation.

## 9. Some Aspects of Historical Geography in Bengal.

K. N. MUKHERJEE, Calcutta.

As the pioneer work has been done in this field by non-geographers, it is biased with some specific outlook in each case. Therefore the subject has not developed uniformly. Hydrography has developed most, while climate and soil have been neglected. The maps being the most important element to build up the subject, the author has discussed in this paper the contents of a number of old maps and their reliability. Most of the important pioneering works have been referred to in this paper, mentioning at the same time, the nature of contribution they have made in the different fields of Historical Geography.

## 100. Mirzapur : A Study in Urban Geography.

R. L. SINGH, Banaras.

Mirzapur is a sub-city in Eastern U. P., being tributary to the major city of Banaras. It affords an interesting study in that its origin, growth and morphology bear an intimate relationship with both physical and cultural settings. It provides an example of decline of a river port with the advent of railways. Its nodality, however, seems to have infused fresh vitality for its growth as an entrepot.

The character of the Ganga bank has been favourable to the growth of the nucleated settlements of Vindhyachal and Mirzapur which together form now one municipality. Vindhyachal and Kantit, now a village, are ancient centres, while Mirzapur probably did not originate till late in the 17th century. Mirzapur had become a great mart as early as 1760, being resorted by the Sunnias merchants of the Deccan and Bengal. From 1800 to 1850 it was the most important trading centre of upper India and had an important custom house, being at the head of steam navigation on the Ganga. With the completion of the Eastern Railway in 1864 up to the Yamuna bank at Allahabad, the decline of the city started because the boat traffic of the upper reaches could now be transferred to railways at Allahabad.

The impact of the decline of its inland trade is seen on the movement of population of the city. The population fell from about 90,000 in 1772 to 32,000 in 1911. But it has shown an increase of over 57% during the last three decades, chiefly owing to the improvement in road transport and subsequent increase in local trade. About one-third of its total population is engaged in trade and transport, and nearly the same, in non-agricultural production. Mirzapur is one of the most important centres of cottage industries in Eastern U. P., being a leading centre in Carpet and Shellac manufactures. Factory industries are, however, quite insignificant.

The triangular plan of the city appears to have been influenced by the natural and cultural forces of the site. The base of the triangle is formed by the Ganga bank and the apex lies southward at the railway station. The stability of the bank coupled with its immunity from the danger of floods afforded a naturally favourable water frontage. The southward pull was perhaps exerted by the Great Deccan road which was the chief route to the south during the 19th century.

Mirzapur as a district centre serves the Vindhyan plateau and the Sonpar country most of which is still inaccessible. Owing to the lack of a bridge on the Ganga the area North of the river is in direct contact with Banaras. It is quite possible that with the development of the Rihand Dam Scheme the regional function of Mirzapur may increase many-fold and the city may become a regional capital in the Umland of Banaras.



**101. Relocation and Re-development of the Indian Sugar Industry—A Study in locational Geography.**

MONORANJAN CHAUDHURI, Calcutta.

The aim of scientific location is to maximise profit with minimum cost. Unscientific location has largely been responsible for the decline in industrial output in India. The sugar industry of India faces a great crisis.

The "material index" of the sugar industry is greater than unity and hence it is not capable of considerable dispersal. Availability of suitable conditions in U. P. and Bihar and the absence of water supply in the south were largely responsible for the concentration of the sugar cane cultivation in the North Indian plains, initially. Over-concentration of sugar industry in the north has been responsible for industrial erosion in U. P. and Bihar. On the other hand due to extension of irrigation facilities in Hyderabad, Mysore, Bombay, Madras and other areas in the Deccan it will now be possible to produce sugar cane in these areas, in large quantities. The recovery percentage of sugar is also higher in the Deccan. Moreover some of the irrigation projects in the Deccan will not prove economic unless sugar cane is cultivated in those areas. Considering all these factors, pre-location and redevelopment of the Indian sugar industry are suggested. A critical interpretation of industrial concentration and migration and also the economic repercussions of industrial migration are given.

## SECTION OF BOTANY

*President* :—DR. J. C. SEN GUPTA, M.Sc., D.Phil. Nat.

### *Abstracts*

#### BACTERIOLOGY, MYCOLOGY AND PLANT PATHOLOGY

##### 1. **Variability in resistance or susceptibility of different varieties of paddy to infection of *Helminthosporium Oryzae* Breda de Haan.**

S. B. CHATTOPADHYAY and N. K. CHAKRABARTI, Calcutta.

While determining the reaction of different varieties of paddy to infection of *Helminthosporium Oryzae* over a period of three years in different parts of West Bengal, it was observed that besides variation existing among the different varieties of paddy, the intensity of infection was found to vary from year to year even in case of any particular variety. The effect of weather conditions on the development of the pathogen and its dissemination may be the reason of such variation. Another important point of observation was that the reaction of a particular variety to the infection of *Helminthosporium Oryzae* was not the same in different localities, even in the same year. While this may be explained by considering the effect of weather conditions in a particular locality, on the development, sporulation and dissemination of the pathogen, the possibility of existence of different strains of the fungus is also indicated. Physiological condition of the host in different soil and climatic zone may also influence its resistance against the attack of the fungus. These points are being studied to obtain better knowledge of the host-parasite relationship, which is so essential for finding out resistant varieties.

##### 2. **The Potato wilt caused by *Pseudomonas Solanacearum* Var. *Asiatica* (E. F. Smith) Stapp. in West Bengal.**

KRISHNA MUKHERJI and DR. S. B. CHATTOPADHYAY, Calcutta.

Potato plants grown in the plains and hills of West Bengal suffer from a wilt disease caused by *Pseudomonas solanacearum* var. *asiatica* (E. F. Smith) stapp. The disease was believed to be present in Bengal by Butler (1903) but not conclusively shown by him. Bacterial wilt caused by *Pseudomonas solanacearum* was reported in Tobacco by Hutchinson (1913) from Rangpur, in Tomato by Hedaya-tullah & Saha (1941) from Dacca. Bacterial wilt of potato is also present in other parts of India. The organism essentially resembles *Pseudomonas solanacearum* Erw. Smith in morphological characters but differs in biochemical reactions. (1) Milk coagulation—formation of curd in both cream-free milk and milk with cream followed by precipitation of casein. It also produces acid in nutrient broth containing various sugars.

The organism has been found to enter the host tissue when it is injured. This disease is very serious in West Bengal, causing considerable damage both to the standing crop and also to the tubers in storage.

The soil does not appear to play very important part in the perennation and spread of the disease. The control of the disease may be achieved by use of disease-free seed tubers.



### 3. Pigment formation of *Serratia Marcescens* Bizio—reported from India for the first time.

KRISHNA MUKHERJI and DR. S. B. CHATTOPADHYAY, Calcutta.

*Serratia marcescens* Bizio has been isolated from *Agrotis ypsilon* (cutworm of Cabbage) for the first time in India. The morphology of the bacteria has been studied. The organism produces the red coloured pigment Prodigiosin (Porter 1950), the formation of which solely depends upon the presence of organic nitrogen in the medium, aeration and suitable temperature. Considerable variation also exists among the different strains regarding pigment formation. Pigment production is most intense between 25°—30°C, it ceases at 10°C as well as at a temperature of or about 38°C. Transfer of isolates kept at 1° C or 40° C (which becomes colourless at that temperature) to 30°C gradually reverts to red or pink forms. Reversion is more rapid when the cultures are kept at higher temperature.

One true breeding white strain was obtained which did not show any pigment production at any temperature. On storage at 18°C for one week this particular strain showed the production of coloured strains in a few cases. The pigment production appears to be connected with physiological conditions. Some pink strains were found, these were really weaker strains because on aging they tend to become red. White strains appear to degenerate gradually.

### 4. Studies on Tumour Disease of *Coriandrum Sativum* L. caused by *Protomyces Macrosporus* Unger.

H. C. SRIVASTAVA, Mysore.

*Coriandrum sativum* L. commonly known as Coriander was found to be seriously affected by the tumour disease, caused by *Protomyces macrosporus* Ung., in different parts of Uttar Pradesh. The disease generally starts from November and continues up to March. The crop sown in September/October, show less percentage of damage in yield, as compared with the crop sown in November/December. The mode of germination of *Protomyces macrosporus* Ung. was studied in detail. The chlamydospores undergo a period of rest of 4-6 months, and this dormancy could not be broken by use of several chemicals. The maximum germination of chlamydospores was noted at 17°—22°C. and 75% moisture. Thermal death point was at 48°C. Detailed pathogenecitical experiments revealed that the disease starts in very early stage of germination, though the symptoms appear later. Chlamydospores are capable of producing disease through seeds or soil or both. Symptoms were visible by injecting the viable chlamydospores into 3-6 weeks old seedlings.

### 5. Viability of the Chlamydospores of *Protomyces Macrosporus* Unger.

H. C. SRIVASTAVA, Mysore.

The viability of the chlamydospores of *Protomyces macrosporus* Unger, was tested under Laboratory as well as field conditions. The germination percentage was found out of 200 observations in the laboratory, and the infection percentage was taken as average of four replications. It was found that four-year-old chlamydospores showed 41.3% of germination and 28.3% of infection; five-year old showed 15% of germination and 2.1% of infection whereas six-year-old did not show any sign of germination or infection.

### 6. Occurrence of *Humarina* in India.

DR. B. PADHI, Cuttack.

A large number of apothecia, growing on a small patch of burnt soil, have been collected from Cuttack in the month of June, after the break of the monsoon.

The apothecia are concave cupulate or plane, rarely convex, minute mostly less than 1 mm. diam. few up to 1.5 mm., gregarious, angular with rounded corners, greenish purple, sessile, subicle absent, hypothecium conspicuously developed. Asci clavate, about  $150\mu$  long  $10-12\mu$  broad, operculate, without iodine reaction, eight spored, obliquely uniseriate. Spores broad ellipsoid to oval, hyaline, smooth, containing two large oil drops, entire,  $13-16\mu$  long,  $9-10\mu$  broad. Paraphyses many, straight, slender, filiform, as long as the asci, slightly enlarged at tip to about  $1\mu$  diam. Exciple pseudoparenchymatous,  $20-25\mu$  thick.

The fungus belongs obviously to the genus *Humarina* Seaver that has not yet been recorded from India. Apparently it forms a new species of the genus and the proper name would be published elsewhere.

#### 7. Leaf Scorch of *Pongamia glabra*.

B. PADHI, Ph.D., Cuttack.

A leaf scorching disease has been observed on *Pongamia glabra* Vent. at several localities in the Districts of Cuttack and Keonjhar, of Orissa State. The disease begins on fresh leaves which come out in May. The spots, that start as small and scattered, grow indefinitely and often coalesce, forming conspicuous irregular patches. Ultimately scorching and defoliation take place. The upper surfaces of the affected leaves show only distinctly pallid discolourations. On the lower surfaces develop innumerable acervuli, erumpent and tuberculiform, brown in colour, about  $100\mu$  in diameter. The sporophores are simple cylindrical about  $25\mu$  long, subhyaline. The conidia are greyish brown, cylindrical, about  $17\mu$  long and  $5\mu$  broad, rounded at upper end, with a truncated papilla at the lower end, uniseptate near the middle.

The fungus pathogen seems apparently related to *Phacomarsonia* Speg., a genus of doubtful validity. The exact name of the fungus would be published elsewhere after further studies.

#### 8. Enrichment of Soil Plate for the Isolation of Specific Organisms.

S. K. MAJUMDER and NIRAD K. SEN, Kharagpur.

Winogradsky's soil plate method for the isolation of *Azotobacter* is widely practised. With different samples of local soil it was found that by increasing the starch (soluble) content to 10 and 15% many more *Azotobacter* colonies were obtained. Pure soluble starch can be replaced by barley powder, but then, some other sporulating bacteria also developed along with *Azotobacter* on those plates and the smoothness of the plates was spoiled with irregular swellings which developed with generation of foul smelling gas. Enrichment of the soil plates with 2.5-5% sucrose soln. gave rise to large number of *Azotobacter* colonies and in general they developed within 48 hrs. of incubation, when 72 hrs. were needed with soluble starch. In the sucrose plates, however, *Azotobacter* colonies were masked by fungal colonies after 3 days of incubation. Incorporation of nitrogenous salts like ammonium sulphate and sodium nitrate (1% soln.) to soil starch plates gave rise to large number of fungus colonies and the specificity of starch for *Azotobacter* was lost. When soil starch plates were enriched with Czapek's soln. (1%) white floccose mycelia of *Cunninghamella* sp. developed on the plates of the soils having its spores. It seems that enrichment with Czapek's soln. (1%) exerts selective growth of *Cunninghamella* sp. and this technique may be developed for its isolation.



## 9. Origin and developmental morphology of the root nodules on *Cicer arietinum* L.

NIRMAL, ARORA, Delhi.

The roots of *Cicer arietinum* show numerous branched nodules, with pinkish tips and narrow brownish bases. The rhizobia enter through the root hairs. The passage of the infection thread can be clearly marked out by the presence of narrow elongated cells up to the centre of the nodule. Occasionally a single nodule may show two infected root hairs.

The infection thread induces meristematic activity in the cortical cells and its branches spread to the newly formed daughter cells. A young nodule consists of highly vacuolated cortical cells containing large nuclei. With the multiplication of the bacteria the cells increase in size, the vacuoles coalesce, and darkly staining chromatin bodies appear in the hypertrophied nuclei. The nodule never emerges out of the root cortex though its enlargement ruptures the epidermis and the cortical layers.

A mature nodule is differentiated into the three typical regions: an apical meristem which adds new cells to the nodular tissue, the bacteroid area showing a gradation from the newly infected cells to the degenerating portion, and a nodule cortex traversed by vascular strands enveloping the bacteroid zone.

The meristem does not cease to function even after the beginning of degeneration in the bacteroid cells. The mature infected cells are much enlarged and have a central vacuole with the large deformed nucleus pressed at its side. Intermingled with these are small uninfected cells which are devoid of bacteria, and have a small nucleus, scanty cytoplasm and abundant starch grains. In some cells of the nodule cortex also starch grains are present. Two to four vascular strands arise from one or two protoxylem groups of the central cylinder and they branch in the nodule to produce as many as 20 traces. Each bundle is inversely collateral and is surrounded by a typical endodermis.

Root tubercles without bacterial infection have also been observed. Such swellings consist of large parenchymatous cells without differentiating into zones and have a central vascular strand.

Unlike other herbaceous legumes investigated by Allen and Allen (1940) Bond (1948), and Thornton (1930) the infection thread in *Cicer* passes through some especially differentiated and elongated cells in the cortex which can be recognised even after the nodule is mature.

## 10. Survey of antibiotic-producing actinomycetes from Indian soils IV.

A. K. MISHRA, A. DAS GUPTA AND M. PURAKAYASTHA, Calcutta.

Several *Streptomyces* strains isolated from different parts of India were tested for antibacterial and antifungal properties both by cross-streak method and by agar-cup method. Of the 116 strains tested for antibacterial activity 43 were found to be active against at least one test organism, of which 23 had action against gram-positive, 17 against both gram-positive and gram-negative, and 3 against only gram-negative bacteria. Of the 106 strains tested for antifungal activity, 46 showed activity against at least one test fungus.

## 11. Antibiotic activities of some fungi from the soils of West Bengal.

S. K. MUKHERJEE AND P. N. NANDI, Calcutta.

63 Soil samples were plated out in suitable media for the isolation of soil fungi. Of 540 isolates 231 fungi were tested against pathogenic bacteria and plant pathogenic fungi. Of them 139 strains (60.1%) were inhibitory to Gram-positive bacteria, 96 strains to Gram-negative bacteria and 125 strains (54.5%) to pathogenic fungi.

om the strains active to gram-positive bacteria 50 were identified and assayed in tails. It was observed that 100% were inhibitory to *Staph. aureus*, 70% to *E. coli*, % to *Eb. typhosa*, 16% to *V. cholerae* and 12% to all the bacterial test organisms. hen assayed against plant pathogenic fungi, 38% were found to be positive to *solani*, 46% to *C. specifera*, 52% to *H. oryzae*, 24% to *Fusarium* sp. 44% to *izoctonia* sp. and 20% to all the test fungi. Of the strains examined, *Penicillium rmiculatum*, *Penicillium variable*, *Curcularia lunata*, *Trichoderma glaucum* and *nicillium steckii* deserve special mention due to peculiarities of their antagonistic haviour. To our knowledge, antibiotic activity from *P. variable* and *Curcularia nata* has not been reported elsewhere. Among the antagonistic fungi, species of *nicillium* and *Aspergillus* are found to be fairly distributed in the soils of West ngal.

## 2. Biological studies on a strain of *Streptomyces* producing an antifungal antibiotic.

A. K. BANERJEE AND P. NANDI, Calcutta.

AC<sub>4</sub> 248, a strain of *Streptomyces*, perhaps belonging to the *griseus* group as isolated. Its cultural character were compared with a standard strain of *. griseus* following Bergey's Manual. The strain while growing in liquid media rned the fermentation beer highly antifungal against a number of phytopatho- enic and saprophytic fungi including yeast. Remarkably enough, the strain did ot possess any antibacterial action against any of the 7 test bacteria. Growth nd antibiotic production of the strain in 9 different liquid media were studied. a molasses-peptone broth was found to be the best medium. Growth and anti- biotic production in this medium were studied in shake and still cultures. Shaking improved antibiotic titre but growth was adversely affected.

## 3. Chromatographic Identification of Soluble sugars in Healthy and Diseased seeds of *Coriandrum Sativum* L. affected by *Protomyces Macrosporus* Ung.

J. S. GUPTA, Agra.

Extract of healthy and diseased seeds of *Coriandrum sativum* in 80% alcohol were tested for the presence of soluble sugars by descending filter paper chromato- graphic method. The chromatograms were developed in the upper layer of n- butanol-acetic acid-water mixture, dried at room temperature, sprayed with benzi- dine reagent and heated at 95-100°C for three minutes.

Fructose, glucose, sucrose and one unidentified sugar were detected in healthy seeds and only glucose was found to be present in diseased seeds. The R<sub>f</sub> value of the unidentified sugar is lower than that of the three tested trisaccharides (sucrose, maltose and lactose). Thus the unidentified sugar may be a trisaccharide or a disaccharide other than sucrose, maltose, and lactose.

## 14. Two species of *Chytridium* from Lucknow.

S. N. DAS-GUPTA AND (Miss) RACHEL JOHN.

During the search for aquatic fungi some algae, viz., *Spirogyra* collected from a ditch in the vicinity of Lucknow showed the presence of sporangia and resting spores of a fungus. These sporangia and resting spores were of two types and were later on identified as two species of the same fungus, viz., *Chytridium Schenkii* and *C. lagenaria*. Although considerable work on this fungus has been done in other countries, no report of it has so far been made from India. This paper deals with the description of the two species found in *Spirogyra*. In both cases the zoospores after infection forms an endobiotic apophyses which bears



rhizoids at the basal end and an epibiotic sessile sporangium at the distal end. The sporangium in *C. Schenkii* is elongate, pyriform, saclike and either erect or procumbent whereas in *C. lagenaria* it is erect and spherical or subspherical. In both cases it opens by an operculum allowing the contents to escape. Zoospores were not observed. The resting spores of *C. Schenkii* have no rhizoids whereas in *C. lagenaria* they are well developed. At maturity the resting spores in both cases form epibiotic sporangia which function as the ordinary sporangia. The differences in the nature of the sporangia, apophyses, resting spores and rhizoids enable the provisional identification of the two species as *C. Schenkii* and *C. lagenaria*.

## BRYOPHYTA

### 15. On the occurrence of "gemmae" in *Mnium* sp.

C. SRINIVASAN, Annamalainagar.

Vegetative reproduction of *Mnium* sp. by the formation of gemmae during the desiccating condition of summer has been studied. These gemmae are obconical multicellular, club shaped and are produced in clusters of two to four in the axils of leaves and they are safely protected in the dry season by a thick matrix of Cyanophyceae which retain moisture to a considerable extent.

No formation of gemmae was observed in these moss plants growing in the same season in moist surroundings. However, on the advent of monsoon these gemmae germinate and develop into a large number of plants forming extensive patches. The capsules are also formed under favourable conditions.

### 16. On a New Species of *Cephalozia* Dum. from Pachmarhi, Madhya Pradesh.

S. K. PANDE AND K. P. SRIVASTAVA, Lucknow.

In a preliminary paper on the Hepatic Vegetation of Pachmarhi the author (Pandé, S. K. and Srivastava, K. P., 1952, Jour. Ind. Bot. Soc., Vol. XXXI pp. 342-351) recorded 32 species of liverworts from this plateau, including a few species apparently new to science. Among the latter the taxonomic details of a species of *Cephalozia* Dum., has since then been studied. It belongs to the section bicuspides and is monoecious. The plants grow associated with *Reboulia hemispherica* (L.) Raddii, loosely entangled amongst its rhizoids, and are flagelliferous and sparingly branched. Female inflorescence occurs on very short posterior shoots and is terminal. The perianth is exerted, ovato-cylindrical and plicate below the mouth. Androecia are terminal on the main stem or on short lateral shoots, sometimes placed by the side of the female shoot, and are spicate and monandrous. Antheridia are ovate, globose and shortly stalked. The species differs from all the known species of the genus in its taxonomy and is, therefore referred to a new species.

## GYMNOSPERMS

### 17. On the Anatomy of the Acclimatised Conifers of South India.

(Miss) C. P. GODAVARI, Annamalainagar.

1. An anatomical study of a total of 32 species of acclimatised Conifers of South India has been done. They comprise 5 species of Araucarineae, 6 under Abietineae, 1 under Taxodineae, 17 under Cupressineae and 2 under Podocarpineae.

2. Anatomical study has also been done of seedlings of *Araucaria* and *Pinus*.
3. Bars of Sanio were observed in all the species investigated. Therefore it argued, that no special phylogenetic importance can be attached to this feature.
4. A different type of Callitroid thickening has been found (resembling eye-ds) in 2 species of *Callitris* namely *C. oblonga* and *C. calcarata*. But it is completely absent in *Callitris rhomboidea*.
5. In the wood of seedling anatomy of *Pinus* and *Araucaria*, uniseriate pittings have been found exclusively without even the vestige of multiseriate pitting. So this feature has been considered as primitive and multiseriate pittings as derived. Professor Jeffrey's theory of the Araucarineae having the most advanced phylogenetic status among the Coniferales has been supported.
6. Based on the study of a complete absence of resin canals in the mesophyll and the vascular bundle of the leaf of *Araucaria cookii*, it has been opined that this species is the most advanced amongst the five species of Araucarineae investigated in the present communication.
7. A new type of endodermis has been recorded in 2 species of *Pinus* namely *P. sabiniana* and *P. palustris* in which the external tangential walls of the endodermal cells are heavily thickened.
8. In *Pinus longifolia*, curiously enough on a shoot of unlimited growth, spurs of bifoliar and trifoliar nature have both been found occurring together promiscuously.

## 18. Contributions to the life history of *Ephedra campylopoda*.

### 1. Male and Female Gametophytes

N. NARANG, Delhi.

*Ephedra campylopoda* is characterized by having two kinds of strobili, one being strictly monosporangiate and the other having microsporangia below a single or a pair of megasporangia. The megasporangium of a bisexual strobilus differs from the normal megasporangium in having a short, abortive and distorted micropyle.

A group of hypodermal archesporial cells differentiates in each lobe of the microsporangium. They cut off a primary parietal layer which divides to form one wall layer and the tapetum. The wall layer is soon crushed and absorbed, while the cells of the tapetum enlarge and become multinucleate. The microspore mother cells undergo simultaneous meiotic divisions.

The mature pollen grain has two prothallial nuclei, a stalk and a body nucleus enclosed in a common sheath of cytoplasm, and a tube nucleus. They are thus 5-nucleate at the shedding stage.

The megasporangium is surrounded by two envelopes which are free from each other except at the base. The inner envelope is fused with the nucellus in the lower part and is 2-3 layered.

A single hypodermal archesporial cells cuts off a primary wall cell and a megaspore mother cell. The wall cell along with the nucellar epidermis produce a massive parietal tissue resulting in the burying of the megaspore mother cell deep into the nucellus.

A tetrad of four megaspores is formed, but sometimes only three cells may be seen, due to a failure of the upper dyad cell to divide. The chalazal megaspore is functional.

The female gametophyte becomes cellular only when a large number of free nuclei have been produced. At this stage it is more or less differentiated into an upper loosely formed archegonial region, the middle storage tissue and the lower haustorial region.



The number of archegonia varies from 2 to 7. Those lying at the micropylar end possess a massive neck of about 32 cells. Others lying in a somewhat lower position seem to be devoid of necks.

The archegonial initial divides into a neck cell and a central cell. The nucleus of the central cell usually lies at the upper end of the archegonium but in some cases it is seen to occupy a somewhat lower position. This altered position is due to the upward extension of the tip of the central cell leaving the central nucleus behind. The central nucleus divides to produce a small ventral canal nucleus and a large egg nucleus which sometimes develops a beak-like structure. No wall is laid between the two nuclei.

The nucellus has a prominent pollen chamber. Some of the gametophytic cells divide very actively and protrude into the pollen chamber forming a structure comparable to the "tent pole" met with in *Ginkgo*.

Lateral archegonia, occurring singly or in groups, have also been recorded though they are not of a common occurrence. They are characterised by the absence of necks, but possess the usual egg and ventral canal nuclei.

## 19. Contributions to the life history of *Ephedra campylopoda*.

### 2. Fertilization and Embryogeny

N. NARANG, Delhi.

At the time of fertilization the outer envelope of the megasporangium becomes several layered. The innermost layer puts out papillate projections which block the space between the outer and the inner envelopes.

The egg nucleus occupies a central position and the ventral canal nucleus is situated at the micropylar end. But occasionally the former travels to the base of the cell while the latter is seen in the central position.

The cytoplasm of the central cell becomes almost homogeneous with the disappearance of the vacuoles. The egg nucleus is surrounded by a sheath of dense cytoplasm which may extend down to the base of the archegonium.

The two male cells have been found to lie very close to the ventral canal nucleus. In another preparation the actual fusion of male cell with the egg nucleus has been observed, there being no indication of the second male cell fusing with the ventral canal nucleus. But judging from the larger size and the persistent nature of ventral canal nucleus there seems to be no doubt that the second male cell fuses with it.

Many of the jacket cells become 2- to 4-nucleate by mitotic divisions. Usually the walls of the jacket cells break down and their contents migrate into the central cell. In some cases intact jacket cells migrate into the central cell and may come to lie next to the egg nucleus.

The oospore usually produces eight proembryonal nuclei by three successive divisions. In one case only 6 nuclei were observed, this may be due to the failure of some proembryonal nuclei to undergo further divisions or due to an early degeneration of two proembryonal nuclei. The free nuclei are scattered in the lower half of the central cell.

Each nucleus is spherical in shape and is surrounded by a cytoplasmic sheath with radiating bands. Further development is accompanied by the formation of a tubular outgrowth from the cell. The first division is transverse and cuts off the suspensor cell from the embryo initial. During later stages 2-7 embryos have been observed out of which only one reaches maturity.

The occurrence of bisporangiate strobili, two prothallial nuclei, a stalk nucleus and lateral archegonia are some of the features which *Ephedra* shares with the conifers.

## ANGLOSPERMS

0. Origin and development of the vegetative axillary bud in *Vitis repens* W. & A.

A. R. CHAVAN and J. J. SHAH, Baroda.

The ontogeny and early procambialization of the vegetative axillary bud is described for *Vitis repens* W. & A. The axillary bud has its origin in the second pericycle layer and inner corpus cells of the apical meristem. It is first perceptible in the axil of the first leaf primordium. In its further development, the basal cells of the early leaf primordia are also associated. Ultimately by subsequent growth processes the axillary bud comes to lie on the adaxial surface of the leaf base. The procambium formation is associated with the origin of a pair of prophyll primordia, which usually arise from the axillary bud of the fourth leaf primordium. The procambium of the bud develops in basipetal direction and meets the procambium of the shoot which also develops acropetally. The differential behaviour of the apical and bud meristem is discussed with reference to experiments on the apical meristems, carried out by Ball (1952) and Wardlaw (1952). The leaf primordium arises from the bud apex at the fifth leaf primordium behind the shoot apex. It is soon followed by the origin of the tendril primordium.

21. "Some Observations on the Abnormalities of *Tecoma Stans*."

S. Y. GUPTA, Visnagar (N. Guj.).

While collecting specimen in the College Garden Visnagar, the following abnormalities in the flower of *Tecoma Stans* L. have been observed by the author:

- (i) Two types of flowers, one with all five fertile stamens and another with four and half fertile stamens and only one half staminode.
- (ii) The abnormal flowers born on one particular branch of one particular individual only.
- (iii) The daughter plants from the seeds of the special branch did not inherit the above abnormalities.

The author is of the opinion that this may be due to some mutations which are not inherited. The genetical study of the vegetative and the reproductive parts taken up by the author may throw some light on this.

## 22. Studies in Lauraceæ—II.

R. L. N. SASTRI, Waltair.

The paper describes the structure and development of the pollen, embryo sac, endosperm and seed in *Cinnamomum iners* and *C. zeylanicum*.

The anther wall is five layered. Anther tapetum is of amoeboid type. Dehiscence of the anther is brought about by the formation of fibrous endothecium only in a certain portion of the anther wall and the breaking away of that portion of the anther wall as a valve. Cytokinesis is by cell plate formation. Division of pollen mother cells is successive. Pollen grains are a-porate and three celled at the time of shedding.

The ovule is bitegmic, circinotropous and crassinucellate and shows a nucellar cap at the micropylar region. The micropyle is formed by the inner integument. The archesporium is multicellular. However, only one of the archesporial cells is functional. It cuts off the parietal cell and forms the megaspore mother cell. The nucellar cells show conspicuous nuclei and dense cytoplasm till the four nucleate embryo sac is formed. The megaspore mother cell forms a linear tetrad of which the chalazal megaspore is functional. The embryo sac is of the Polygonum type. The antipodals are ephemeral and the synergids are devoid of hooks in *C. iners* and they have hooks in *C. zeylanicum*.



Endosperm primordium divides earlier than the zygote. Endosperm is nuclear. Wall formation starts from the micropylar end at about the time the embryo is globular.

The outer integument of the ovule becomes many layered in the mature seed and some of its cells are filled with tannin. The inner integument is greatly reduced and in the mature seed only its remnants could be seen. In the developing seed the nucellus surrounds the embryo sac as a loose thin walled perisperm. The embryo occupies a cavity at the micropylar region, formed by the breaking down of the nucellar cells there. In the oldest seeds the massive cotyledons fill the entire space. The perisperm and endosperm are consumed to a great extent.

The cells of the inner epidermis of the fruit wall in the micropylar region become columnar, thick walled and pitted.

### 23. The Embryology of *Ceratophyllum Demersum* L.

R. L. N. SASTRI, Waltair.

The anther wall is four layered of which the innermost forms the tapetum which is of amoeboid type. Fibrous endothecium is absent. Dehiscence of anthers takes place irregularly. The exine of the mature pollen grains is not thickened and has no germ pores. Pollen grains are two celled at the time of shedding.

The ovule is unitegmis, anatropous and crassinucellate. Archegonium is single celled. A primary parietal cell is cut off. Megaspore tetrads are linear or T-shaped. The chalazal megaspore of a tetrad functions while the others degenerate. Embryo sac is of Polygonum Type. Antipodals persist till the zygote completes the first division. Synergids have hooks. Polar nuclei fuse before fertilization.

Endosperm is cellular. The first division of the endosperm primordium is accompanied by the partitioning of the embryo sac into two approximately equal chambers. Later only the micropylar endosperm cell undergoes further divisions and forms a small mass of endosperm cells below the embryo. At about the time the embryo is globular the chalazal endosperm cell divides once.

Embryo development conforms to the Asterad Type and keys out to the Penaeae Variation. The cotyledonary lobes arise from a common primordium and they surround and overhang the stem apex as in Nymphaeaceae. In the mature seed the cotyledons become massive, fill the entire space and their cells are filled with starch grains. The plumule has well developed leaves arranged in whorls and in the axils of some of the leaves axillary buds are also seen while still inside the fruit. The embryo is supplied with vascular supply which is in the procambial stage. Endosperm is absent in the mature seed.

The seed coat consists of one or two layers of thin walled cells. The fruit is an achene. The fruit wall gives out three hook-like protuberances. It consists of an outer zone of thin walled cells and an inner zone of 4-5 layers of thick walled cells.

### 24. Physical and Chemical Properties of Bast Fibres in relation to their Intrinsic Strength.

S. M. BETRABET and B. S. NAVALKAR, Bombay.

The fibers of 16 fiber yielding plants of cohort Malvales of Bombay were extracted by "Water retting" method in small concrete tanks. The physical and chemical properties of the fibres were studied with reference to L/D ratio, Cellulose, Nitrogen and Fat contents etc. Further an attempt has been made to correlate the physical and chemical properties of the fibres with their intrinsic strength. It could be observed from the results that longer the ultimate cells, higher the L/D ratio, higher the cellulose content. Lower the fat and wax as well as lower the nitrogen contents, higher is the intrinsic strength.

The importance of these investigations lies in the possibility of assessing the quality of a fiber from a preliminary examination, which could be useful in connection with the breeding trials.

## 25. Microsporangium, Microsporogenesis and Male Gametophyte of *Mimosa Rubicaulis* Lamb.

B. N. MULAY and B. S. DHAMI, Pilani.

1. The inflorescence is a globose head and consists of 50-60 flowers, but the number of fruits that are formed per inflorescence are usually 1-2.

2. The primary archesporium is very extensive and is differentiated at a very early period.

3. The anther wall comprises the epidermis, fibrous endothecium, a single middle layer and uninucleate tapetum which is of secretory type.

4. The tapetum towards the inner side of the anther lobe is multilayered with their cells radially elongated and seems to be of different origin, while tapetum on the peripheral side is quite ephemeral and single layered.

5. A very large number of "binucleate microspore mother cells" are produced per microsporangium and these give rise to a large number of compound pollen grains.

6. At synizesis the "twin nuclei" of the binucleate mother cell occupy an eccentric position in the centre of the cell and probably they balance their contents by cytomixis at this stage.

7. Each compound pollen grain usually consists of eight microspores.

## 26. Embryological Studies in Acanthaceae : The Female Gametophyte.

V. G. PHATAK and (Miss) K. B. AMBEGAOKAR, Baroda.

The development and structure of the ovule and female gametophyte were studied in *Tubiflora acaulis*, O. Kuntze. Syn. *Elytraria acaulis*, Linn. and *Barleria Prionitis*, Linn.

Each ovary contains two loculii. In *Tubiflora acaulis* 8 to 10 are present in each loculus. While in *Barleria Prionitis* single ovule is present. Archesporial cell is hypodermal in origin and directly functions as the megaspore mother cell. The integument development starts after the archesporial differentiation and the integument is only one. Integument becomes tapetal at the tetrad formation in *Tubiflora acaulis*. In *Barleria Prionitis* tapetum formation is absent. The nucellus is of only one layer of cells. The chalazal megaspore becomes functional. The development of the embryo-sac is of normal polygonum type. The mature embryo-sac is much more curved in *Barleria Prionitis* than in *Tubiflora acaulis*. The synergids are beak-like and large. Rest of the egg-apparatus is of normal type.

## 27. Studies in the Germination of Seeds of the Leguminosae in relation to the evolutionary tendencies of its leaf.

S. KALYANASUNDARAM, Annamalainagar.

These studies comprise of 150 species spread over 33 genera of the Leguminosae. Seeds were germinated on nursery beds. Observations were directed to the ontogenetic development of leaves in the young seedlings from the very first leaf to the adult. Seedlings so studied have been classified under 21 types and they are grouped under 3 heads shown as under :

- a. Papilionoid : consisting of 14 types.
- b. Caesalpinoid : consisting of 3 types.
- c. Mimosoid : consisting of 4 types.

Each of these types has been fully described in the fuller paper.



A close study of the various types of seedlings reveal that the ancestral leaf of Leguminosae was of simple laminar type and the compound leaf had been derived from the simple leaf by the dissection of the laminar blade into leaflets. There appears to be some correlation between the number and form of the leaflets and the venation pattern of the ancestral leaf.

It is curious to record that although Papilionaceae is the most advanced subfamily of Leguminosae, yet in most of the species the first formed leaf of the seedling is of simple primitive type whereas in Caesalpinieae most of them are of simple pinnate type and in Mimoseae which is the most primitive among the Leguminosae, in most of the species the seedlings possess bipinnate leaves. The range of foliar variation in the various subfamilies observed so far is as follows:

a. Papilionaceae: Simple to simple compound.

b. Caesalpinieae: Pinnate to bipinnate.

c. Mimoseae: Bipinnate.

A close correlation has been drawn up between the first formed leaves on the seedlings and adult leaves on mature plants; and it has been found that in general ontogenetically Papilionaceae is correlated with simple leaves and Caesalpinieae with compound leaves and Mimoseae with bipinnate leaves. It will therefore, be seen that although Papilionaceae is the most advanced subfamily of the Leguminosae in its floral structure, it appears to be the most primitive in its foliar ontogenetic evolution, while Mimoseae which is regarded as the most primitive amongst the Leguminosae in its floral characteristics, appears to be most highly evolved in its foliar character, and Caesalpinieae obviously occupies an intermediate position both in the line of floral evolution as well as foliar evolution.

The question therefore arises whether a species is a plexus of primitive and advanced characters. This aspect will be discussed at length while presenting this paper during the session of the Botany Section.

## 28. Studies in Leaf form on venation of Vascular Plants—II (Verbenaceae).

PADMINI DEVI (Mrs.), Annamalainagar.

A study has been made of leaf form and venation on similar lines as those of Dr. Ettingshausen of the following eighteen species belonging to the family Verbenaceae spread over twelve genera.

- |  |   |
|--|---|
| 1. <i>Citharexylum</i> sp.               | 10. <i>Stachytarpheta indica</i> Vahl.  |
| 2. <i>Clerodendron Thomsonae</i> Baif.   | 11. <i>Duranta stenostachys</i> .       |
| 3. <i>Clerodendron splendens</i> G. Don. | 12. <i>Duranta alba</i> .               |
| 4. <i>Gmelina arborea</i> Linn.          | 13. <i>Duranta plumieri</i> Jacq.       |
| 5. <i>Verbena chamaedrifolia</i> Juss.   | 14. <i>Lippia nodiflora</i> Mich.       |
| 6. <i>Petraea arborea</i> .              | 15. <i>Lantana coccinea</i> .           |
| 7. <i>Petraea volubilis</i> Linn.        | 16. <i>Lantana depressa</i> .           |
| 8. <i>Vitex simplicifolia</i> Clarke.    | 17. <i>Holmskioldia sanguinea</i> Retz. |
| 9. <i>Vitex negundo</i> Linn.            | 18. <i>Priva leptostachya</i> Juss.     |

A tentative classification has been erected mainly on the size, shape, venation and margin, and apex of the leaves. A noteworthy feature is that leaves show a gradual transition from entire margined leaves to serrate margined leaves from Acanthaceae to Labiateae, Verbenaceae forming the connecting link between the two. It is also interesting to note that in certain respects, this tentative classification agrees with those of Benthem-Hooker and Engler-Prantl.

## 29. A Revision of the Indo-Malayan species of *Viscum* Linn.

SESHAGIRI RAO, Calcutta.

The present revision is an extension of Danser's studies on the British Indian species of *Viscum*. The genus is mainly distributed in the tropics. Africa claims

the largest number of species—as many as 50, Madagascar, about 40 species and the Indo-Malayan region, only 15 species. On the basis of the available data, it appears that the line of distribution might have proceeded from Africa to India through Madagascar and gradually extended further east as far as Japan on one side and tropical Australia on the other.

This revision has considerably augmented the number of species and varieties known for India and Burma and further enlarged the areas of distribution of many species. *V. loranthi* Elmer which exhibits a peculiar discontinuous distribution occurring in China, Luzon, Sumatra and the Western Himalayas, has been newly recorded from the Manipur hills, Assam. *V. ovalifolium* A.P. de Cand., a purely Malayan species reaching as far as Burma, has been now found out to occur in Assam as a new record for India. *V. articulatum* Burm. var. *liquidambaricolum* (Hayata) Seshagiri Rao, nov. var., *V. articulatum* Burm. var. *thelocarpum* (Danser) Seshagiri Rao, nov. comb. and *V. acaciae* Danser var. *obovalifolium* Seshagiri Rao, var. nov. are the new varieties and combinations.

A detailed illustrated account of all the species and varieties of India, Burma and Malayan Archipelago with the nomenclatural changes is given in the paper.

### 30. Stem anatomy of Convolvulaceae.

MISS N. K. PARULEKAR, Andheri.

The stem anatomy of eighteen species from the Convolvulaceae is worked out in this paper. Clothing hairs are composed of short (thick-walled stalk-cells bearing long, thick-walled, vertical, rarely oblique or even horizontal, terminal cells. Clothing hairs in *Porana malabarica*, *Jacquemontia violacea* and *Cressa cretica* have branched terminal cells. Hairs are absent in *Cuscuta reflexa*.

The glandular hairs have only vertically divided heads. In *Cressa cretica* additional glandular hairs with oval heads divided both by vertical and horizontal walls are observed.

Laticifers and sphaeraphides are characteristic features of this family. However, the laticifers are not found in *Porana malabarica*, *Jacquemontia violacea* and *Cressa cretica*.

Primary xylem vessels are arranged in definite, radial rows forming a closed cylinder. Vascular bundles are bicollateral except in *Cuscuta reflexa*.

Intraxylary phloem develops late in *Jacquemontia violacea*. Medullary phloem bundles occur in many plants. Bicollateral as well as single xylem and phloem bundles are observed in pith of *Argyreia speciosa*.

Both outer and inner cambium is active in most plants.

Occurrence of interxylary phloem is very common. Successive strips of cambium are developed in some plants. In few cases secondary growth is more on some arcs.

Inner cambium develops inversely oriented bundles in *Argyreia speciosa*, *Leitsonia setosa*, *Quamoclit coccinea* and *Jacquemontia violacea*. Second ring of inversely oriented bundles is observed in older stems of *Argyreia speciosa*.

Phellogen develops superficially.

### 31. Origin and Development of Axillary Buds in *Hibiscus cannabinus*.

B. C. KUNDU and N. S. RAO, Barrackpore.

Buds, in *Hibiscus cannabinus*, develop from the bud initials, which have originated in the primordial meristem and have been detached in the axils of leaf primordia during vacuolation and growth. These detached meristems are always connected with the primordial meristems through residual meristematic cells. The bud meristems occupy exactly axillary position after vacuolation; but



after some growth and with the emergence of the bud, the bud becomes foliar in position. This is brought about in two phases. First, only the superficial portion of the bud inclines toward the leaf and grows along with it. Later, growth in the foliar buttress area displaces the bud to the leaf base.

Differentiation of procambium is acropetal to the bud meristem and within the bud after growth. Procambium of the bud splits up into two arcs in younger buds as is seen in plants having opposite phyllotaxy. In older nodes, the course of procambium is seen as in alternate phyllotaxy. A bud gap above the divergence of the bud does not form. The expanding ray cells and the oblique course of the vascular tissue sometimes give false impression of a gap above the bud trace. A gap, however, develops opposite the bud, breaking the straight vertical course of the vascular strand and occurs above the dorsal strand of the bud.

In the bud phloem differentiates acropetally like the procambium and precedes xylem differentiation by five plastochrons. With the initiation of the first prophyll there is a sudden increase of phloem groups, the number exceeding the prophyll traces. Xylem differentiates, first near the base of the bud near the axil region and is discontinuous. Differentiation of xylem proceeds basipetally downwards and acropetally upwards.

Classification of possible types of bud development has been attempted and stress has been laid on the necessity of a wider search of all possible types of development.

## 32. Embryological Studies in *Palmae*—I.

C. VENKATA RAO, Waltair.

Organogeny and development of the male gametophyte were studied in *Borassus flabellifer* L. and *Areca catechu* L. and development of the female gametophyte in *Areca catechu* L., *A. concinna* Thw. Enum. and *A. triandra* Roxb.

The floral organs arise in acropetal sequence; calyx, corolla, stamens or staminodes, pistil or pistillode. The thalamus between the calyx and corolla in *Borassus* grows into a cup which surrounds the pistillode.

The archesporium of the anther consists of 1-2 rows of hypodermal cells in each of its four lobes. The anther wall becomes 4-6 layered. One or more sub-epidermal layers develop fibrous thickenings and 1-2 of the innermost layers function as the tapetum which is of the secretory type. In *Borassus flabellifer*, the tapetal cells remain 1-nucleate while in *Areca* they become two nucleate early. In *Areca* the primary sporogenous cells function directly while in *Borassus* they undergo a secondary increase. Microspore tetrads are tetrahedral and cytokinesis is by simultaneous cell plate formation. Pollen grains are shed in the 2-celled condition. The generative cell is crescent shaped and devoid of starch grains. The exine is reticulately thickened and in *Borassus* shows papillate outgrowths. The pollen grains are monocolpate. The cells of the anther wall and connective show abundance of tanning and raphides.

The ovules are amphitropous till the time of fertilisation and become anatropous afterwards in *Areca*. They are crassinucellate and bitegmic. The outer integument is massive and traversed by branching vascular bundles. The micropyle is formed by both integuments. In *Areca catechu* it is pore like but in the other two species, it has the form of a narrow elongated tube. The epidermal cells of the funicle divide repeatedly in a transverse manner and form radial rows of glandular cells. These run continuous with similar cells of the stylar canal and function as the transmitting tissue. The nucellus gets crushed by the enlarging embryo sac. Only the nucellar epidermis persists just below the micropyle. The antipodal end of the embryo sac is tubular and is invested by a group of thick walled cells. This persists as a postament.

The archesporium of the ovule is 1-celled. It cuts off a primary parietal cell. The megaspore tetrads are both linear and T-shaped. The lowest megaspore functions and forms the eight nucleate embryo sac. The synergids are hooked; the larval nuclei fuse before fertilisation and the secondary endosperm nucleus stands in contact with the egg apparatus. The antipodals are persistent and haustorial. The cytoplasm of the embryo sac shows starch grains.

Abnormal ovaries without ovules, ovules which become sterile due to the degeneration of the embryo sac, and ovules which remain orthotropous or hemianatropous were encountered. Rarely two ovules were seen in a loculus.

## 1. Embryological Studies in *Palmae*—II.

C. VENKATA RAO, Waltair.

Development of the gametophytes is studied in *Pritchardia pacifica*, Seem. and Endl., *P. grandis* and *Actinophloeus macarthurii* Becc.

The flowers of *Pritchardia* are hermaphrodite, and provided with three sepals, three petals, six stamens and three carpels, each with a single ovule. In *Actinophloeus*, the flowers are unisexual and monoecious. There are numerous stamens and a pistillode in the male flowers and the ovary in the female flowers shows a single ovule.

The anthers are 4-locular. The archesporium consists of 1-2 rows of hypodermal cells in each lobe. The primary sporogenous cells undergo secondary increase. The tapetum is multiseriate in *Pritchardia* and the cells become 2-nucleate and radially elongated and protrude among the sporogenous cells. Pollen tetrads are tetrahedral and cytokinesis is by cell plate formation. Dehiscence of the anthers is brought about by fibrous endothecium at a well defined stomium. The mature pollen grains are smooth walled, monolete, 2-celled and spherical or slightly ellipsoidal.

The ovules are bitegmatic and crassinucellate. In *Pritchardia*, they are basal and anatropous. In *Actinophloeus*, they are basal in origin but the ovary grows to the base and takes up the ovule. The funicle between the body of the ovule and the placenta grows so that the ovule in later stages appears pendulous. The stigmas and stylar canal are linked by glandular cells. In *Actinophloeus*, the cells of the funicle are also glandular. In both genera, the outer integument is more massive than the inner and is traversed by several vascular bundles. The micropyle in *Pritchardia pacifica* is zigzag and becomes more so during seed development. In *P. grandis* it is formed only by the inner integument and is narrow, straight and elongated. In *Actinophloeus* also it is straight. In *Pritchardia* the inner epidermis of the inner integument and the nucellar cells surrounding the lower part of the embryo sac develop into an endothelium with conspicuous radially elongated highly protoplasmic cells. These persist for some time during fruit formation. The ovule is ellipsoidal but the fruit and seed become spherical. The endosperm is not ruminate. It is, however, penetrated by a mass of tannin bearing cells of the chalaza. In *Actinophloeus* the embryo sac expands aggressively after the 3-nucleate stage and becomes very large; it crushes out all the cells of nucellus except the postament which, along with the antipodals seated on it, is left attached to one side of the ovule.

The archesporium is 1-celled. It cuts off the primary parietal cell. Megaspore tetrads are T-shaped as well as linear, and embryo sac develops according to normal-type. The polar nuclei fuse before fertilisation. The antipodals are persistent and become sac like. The synergids are hooked and the cytoplasm of the embryo sac is full of starch.

In *Pritchardia grandis* the sporogenous cells of the anther and ovule degenerate but the latter continue to develop normally for some time.



34. Embryological Studies in *Palmae*—III.

C. VENKATA RAO, Waltair.

Fertilisation, development of endosperm, embryo and seed are studied in *Areca catechu* L.

A fertilisable ovule of *Areca catechu* L. is hemianatropous, bitegmic, with the micropyle facing the base of the loculus. The large sac like antipodals are found on the postament which projects into the sac. The secondary endosperm nucleus stands in contact with the egg apparatus and the cytoplasm of the sac is abundantly supplied with starch.

The glandular cells of the stylar canal and funicle function as the transmitting tissue. Fertilisation is porogamous and the embryo and seed develop without any resting period. Soon after fertilisation the outer integument sends in folds or ruminations which grow centripetally, though they never meet at centre. The inner integument gets stretched and later absorbed. Branches from the vascular bundles of the integument traverse the ruminations. The postament and antipodals disintegrate and the cytoplasm of the glandular cells lining the funicle gets absorbed by the time the fertilised egg divides. The endosperm is nuclear and closely lines the embryo sac and ruminations. It becomes cellular by induration, by the time the embryo in the seed is a globular mass, first around the embryo and then in the region next to ruminations. The large central vacuole of the seed is filled with clear liquid. The walls of the endosperm cells are first thin but later become very thick and pitted due to storage of hemicellulose. The cell cavities also store starch. The endosperm around the embryo is non-ruminate. The outer 8-10 layers of the testa become corky.

Embryo development conforms to the Onagrad Type. The fertilised egg divides transversely. *ca* divides by an oblique wall and its derivatives form the embryo proper while *cb* gives rise to the suspensor which becomes somewhat massive. In the second division in *ca* which occurs by an oblique wall in the larger cell, an epiphysis-like cell is formed whose derivatives seem to form the plumule. The other three quadrants of *ca* form the massive cotyledon and root tip. The stem tip and root tip of the mature embryo become oriented towards the micropyle and stand at an angle of nearly 45 degrees. The embryonal mass breaks off from the suspensor in the later stages of development. The mature embryo is conical and the cotyledon which surrounds the primary axis, leaves a slit through which the plumule can emerge during germination. Branches of the vascular bundle of the primary axis traverse the cotyledon nearly to its tip. Some of the cells of the mature embryo show bundles of acicular raphides.

35. Embryology of Two *Asclepiadaceae*.

C. VENKATA RAO and S. RAMA RAO, Waltair.

Development of the anther, pollen, translator, ovule, embryo sac, endosperm, embryo and seed were studied in two members of *Asclepiadaceae*: *Caralluma attenuata* Wt. Ic. (= *C. fimbriata* Hook.) of *Cynanchoideae* and *Cryptostegia grandiflora* R. Br. of *Periplocoideae*.

The archesporium of the anther consists of a plate of cells, 6-10 in width and several cells in depth. The sub-epidermal cells of the 4-5 layered anther wall develop into the fibrous endothecium and the innermost into the secretory tapetum. The tapetal cells are 1-nucleate in *Caralluma* and 2-nucleate in *Cryptostegia*. In the former, the primary sporogenous cells function directly while in the latter they undergo a secondary increase. Cytokinesis is by cell plate formation in both species. It is successive in *Caralluma* and simultaneous in *Cryptostegia*. Micro-

the tetrads are tetrahedral in *Cryptostegia* and linear in *Caralluma* and aggregated into pollinia. Mature pollen grains are 3-celled.

Ovules are tenuinucellate, anatropous and unitegmic. The single archesporial differentiated in each ovule functions directly as the megaspore mother cell. megaspore tetrads are both linear and T-shaped. The lowest megaspore of a tetrad forms the embryo sac according to the *Normal*-type. The synergids are deeply hooked; polar nuclei fuse before fertilisation. Antipodals are insignificant and last till the time of fertilisation. Starch grains are present in the antipodals and the cytoplasm of the embryo sac.

Fertilisation is porogamous. Endosperm is nuclear and a little of it remains in the mature seed.

Embryo development conforms to the *Linum*-variation of the Solanad Type. The suspensor is long and almost uniseriate. Cotyledons develop from the epidermal cells around the micropyle.

### Embryological Studies in Mango (*Mangifera Indica* L.).

P. MAHESHWARI, R. C. SACHAR and R. N. CHOPRA, Delhi.

Except for a short note by Maheshwari (1934) there is practically no work on the embryology of Indian mangoes. This work was undertaken with a view to find out as to which of the Indian varieties are monoembryonic and which of them are polyembryonic, and also to investigate the behaviour of the zygote after fertilisation in both these types. Along with the Indian varieties—*Desi*, *Rajagir*, *Pairy*, *Olour*, *Bangalore*, *Bauginapalli*, *Rosseau*, *Julie* and *Tiyyamamidi*, there were added 3 from Phillipines—*Higgins*, *Paho* and *Cambodia*—2 from Ceylon—*Chempton* and *Colampan*. A brief account of these is given below.

The endosperm is of the Nuclear type. A considerable number of nuclei are formed along the periphery of the embryo sac. In some cases nuclear fusions have been observed which result in the formation of large polyploid nuclei containing a variable number of nucleoli. Wall formation starts from above downwards and the lower part of embryo sac remains free nuclear for a considerable length of time, but ultimately the whole of it becomes cellular. The mature seeds are nonendospermic.

Of the fifteen varieties investigated only four show polyembryony; *Olour*, *Higgins*, *Paho* and *Cambodia*. The development of adventive embryos is initiated after a number of free endosperm nuclei have been formed. The nucellar cells destined to develop into adventive embryos are confined to the micropylar end of the ovule. They are richly protoplasmic and often contain starch grains. Their number is fairly high reaching up to 40 in *Olour*. However, all of them do not develop with the same vigour so that the number of developing embryos is much less. The embryo initial cells increase in size. Their protoplasm recedes from the parent wall, rounds off and develops a new wall around itself. Soon after one of them divide and produce embryonic masses which gradually protrude into the embryo sac and undergo further development. Owing to a close proximity of the embryonic masses in the early stages of development the adventive embryos exhibit various degrees of fusion.

The total number of adventive embryos varies in different varieties. Their age is from 6-14 in *Olour*, 1-9 in *Paho*, 3-12 in *Higgins* and 2-7 in *Cambodia*.

As regards the fate of the zygote in these polyembryonic varieties in *Olour* and *Cambodia*, the egg degenerates and does not take part in the formation of any embryo; its fate in the other two varieties is yet to be decided.

The remaining 11 varieties are monoembryonic. In *Desi*, *Peter*, *Tiyyamamidi*, *Bangalore* and *Pairy* the embryo is definitely of zygotic origin whereas in *Colampan*, *Chempallan*, *Rajagir*, *Rosseau*, *Julie*, and *Bauginapalli* further study has to be made to determine this point.



### 37. The Systematic Position of *Exocarpus*.

P. MAHESHWARI and MANASI GHOSH, Delhi.

*Exocarpus* is a genus with about 17 species, mostly Australian. It has come into much prominence recently as the result of a publication of Gagnepain and Bureau (1946, 1947) who suggest its assignment to a separate family Exocarpaceae to be placed near the Taxaceae. Lam (1948) places it in the Protangiospermae along with *Salix* and *Casuarina*.

The case for a transfer of *Exocarpus* to gymnosperms has been made out on the basis of the "naked" ovule, the articulated pedicel (recalling *Podocarpus* and *Acmopyle*) and the presence of a pollen chamber.

Suessenguth (1954) has suggested that it is essential to make an embryological study before a decision can be arrived at.

The main results of our study of *Exocarpus cupressiformis* and *E. spartea* are that the pollen grains are 2-celled and the anthers have a fibrous endothecium.

The ovule is orthotropous without any clear distinction into nucellus and integument. The megaspore mother cell gives rise to a row of three cells of which the chalazal functions. The mature embryo sac is 8-nucleate with the usual organization. It differs from that of the other members of the Santalaceae in not having the U or N form.

The first division of the zygote is transverse. Subsequent divisions result in a long filament of cells. Later the lower end of the proembryo becomes thickened but the length is still many times its breadth.

In the development of the endosperm the primary chalazal chamber divides vertically to form two cells. In *E. spartea* these two cells do not divide further but give out many outgrowths and form the chalazal haustorium whereas in *E. cupressiformis* the haustorium is cellular and lobed at the lower end. The micropylar chamber shows repeated cell divisions. There are indications of cleavage polyembryony resulting from proliferation of the suspensor.

The above features show definitely that *Exocarpus* is not a gymnosperm and its proper position is in the Santalaceae although it may be considered as a somewhat aberrant member of that family.

### 38. A contribution to the embryology of *Euphorbia esula* L. and *Chrozophora obliqua* A. Juss.

R. N. KAPIL, Delhi.

This paper deals with the male and female gametophytes of *Euphorbia esula* and development of embryo sac and endosperm in *Chrozophora obliqua*.

In *E. esula* the anther wall comprises the epidermis, fibrous endothecium, two middle layers and the multinucleate, glandular tapetum which is 2-layered in places. Reduction divisions are simultaneous; tetrads may be tetrahedral, isobilateral or decussate, and pollen is shed at the 3-celled stage. The ovule is bitegmatic, crassinucellate and anatropous. The nucellar beak protrudes into the micropyle where it meets the placental obturator. The development of the female gametophyte is of the Polygonum type. Dessiatoff's (1911) statement that *E. virgata* has a 16-nucleate embryo sac has been contradicted by Modilewski (1911) who described a normal 8-nucleate embryo sac in this species. The similarity in the embryo sac development of *E. esula* and *E. virgata* supports Clapham, Tutin and Warburg's (1952) view of a close taxonomic alliance between them.

In *Chrozophora obliqua* the nucellar beak is very prominent and projects beyond the micropyle. The megaspore mother cell produces a triad of which the uppermost member appears to be a dyad cell followed by two megaspores. The chalazal megaspore gives rise to the 8-nucleate embryo sac so that the development

ment is monosporic. The endosperm is Nuclear and centripetal wall formation sets in at the heart-shaped stage of the pro-embryo. This work is at variance with Srivastava and Agarwal's (1953) report that in *C. rottleri* the embryo sac is disporic and the endosperm remains nuclear throughout.

#### 39. The female gametophyte of *Lepeostegeres gemmiflorus* Bl.

S. N. DIXIT, Delhi.

Schaeppi and Steindl's (1942) work on the embryology of *Lepeostegeres gemmiflorus* is rather inconclusive. A reinvestigation of the same species has revealed some interesting features which are reported here.

In *L. gemmiflorus* the organisation of the mamelon is somewhat different from what has hitherto been reported in other members of the subfamily Lorantheae. A longitudinal section of a young bud shows a 3-lobed conical mamelon. At the megaspore mother cell stage nearly 1 mm. of its apex extends into the base of the 2.3 cm. long style. For some time there is more or less concurrent elongation of the style and the mamelon, so that the latter attains a height of 2.4 mm. in the 6.5 mm. long style. Hereafter, the style grows more rapidly and when it is 14 mm. long, the mamelon is inserted at its base to a height of 3.5 mm. only. Finally in an open flower the style reaches a length of 30 mm. but the mamelon does not grow any further.

One to four hypodermal archesporial cells differentiate in each of the three lobes of the mamelon and produce linear tetrads. Usually the basal megaspore of the tetrad is functional and by two successive divisions it develops into a 4-nucleate embryo sac. The two nuclei at the lower end divide first and give rise to the lower polar nucleus and two antipodal cells—the sub-terminal cell being 2-nucleate. At this stage the embryo sac is, therefore, 6-nucleate. In one case two 6-nucleate embryo sacs were observed in a single lobe of the mamelon; one of these was quite normal but the other one showed inverted polarity. The tip of the embryo sac elongates upwards and the 2 nuclei usually lag behind. The latter divide and form the egg apparatus and the upper polar nucleus. Three to four embryo sacs develop simultaneously but they do not extend beyond the mamelon. Their upper ends reach up to only 2 mm. in the style. The lower ends grow into long caeca which proceed down so far as the base of the collenchymatous tube, leaving the antipodals *in situ*.

In *Macrosolen* (Maheshwari and Singh, 1952); *Lysiana* (Narayana, 1954) and *Nuytsia* (Narayana, 1955) the mamelon does not at all extend into the style. In *Lepeostegeres*, during earlier stages, nearly one-third of the mamelon is inserted into the styler canal. In later stages, however, due to elongation of the style practically the same condition is reached as reported in the above genera.

#### 40. Mechanical adaptations to autonomous movements in *Desmodium gyrans* Linn. and *Oxalis repens* Linn.

MRIDULA DATTA, Calcutta.

The above plants belong to different families with dissimilar structures, but both have leaflets with motile pulvini describing similar autonomous gyratory variation movements. The structures of these pulvini have been described in relation to each other and in relation to certain touch sensitive nastic pulvini with up and down movements which have been described elsewhere. These autonomous pulvini are small cylindrical organs with centralised modified wood of spirally thickened elements, a large aerenchymatous cortex and an unbroken epidermis devoid of stomata. There are specialized hairs on the surface. The movement of *D. gyrans* is almost a hundred times faster than that of *O. repens*,



but the method is similar. Movement travels in regular succession round the axis of the pulvini. Elements modified for the conduction of stimuli in nastic pulvini are absent here. Similarities and differences between nastic and autonomous pulvini are noted. Many features common to both these types of motile pulvini are absent in, or dissimilar to, non-motile pulvini.

Modifications in structure have usually been correlated to the particular functions required of the organs.

#### 41. Contribution to the embryology of *Hydrocera Triflora* W. & A.

J. VENKATESWARLU and L. LAKSHMINARAYANA, Waltair.

The development of the floral organs takes place in an acropetal succession.

The primary archesporium in the anther consists of a single row of hypodermal cells. The anther wall consists of epidermis, endothecium and two middle layers which are crushed later on and the tapetum. The tapetal cells extend in between the sporogenous cells and divide them into groups. The cells of the tapetum in the early stages are uninucleate and later become 2-4 nucleate. Tapetum disappears when the mature pollen grains are formed. Division of the pollen mother cells is simultaneous and gives rise to the tetrahedral tetrads. Cytokinesis is by furrowing. Pollen grains show three germ pores. Pollen is shed at the two nucleate stage.

Ovules are tenuinucellate, bitegmic and anatropous.

The female archesporium consists of a single hypodermal cell below the nucellar epidermis. The primary archesporial cell directly becomes the megasporophyte mother cell. No parietal cell is cut off. The embryo-sac development is according to the Allium Type. The fertilisable embryo-sac consists of an egg apparatus consisting of an egg and two non-hooked synergids and two polar nuclei which fuse before fertilisation. The antipodals are very ephimeral. The embryo-sac is slender and very elongated.

Fertilisation is porogamous.

The primary endosperm nucleus divides in the upper part of the embryo-sac and is accompanied by cell wall formation dividing the embryo-sac into a micropylar chamber and chalazal chamber. The latter undergoes only free nuclear divisions and in it are found "endosperm nodules". The micropylar chamber divides transversely to form a row of a few cells and the uppermost enlarges considerably and becomes a branched aggressive micropylar endosperm haustorium which is multinucleate. The cells below it divide and form a cellular endosperm tissue in the upper part of the embryo-sac and the embryo is embedded in this tissue. In the mature seed there is no endosperm.

The embryo develops according to the Asterad type and keys out to the *Erodium* variation.

Fruit is a drupe with a five seeded stone. Only one seed in each loculus develops finally while the two other ovules in each loculus degenerate. The seed coat shows two regions, an outer zone of sclerotic cells and inner of parenchymatous cells.

#### 42. Origin and Distribution of *Saccharum* Linn.

SUNIL KUMAR MUKHERJEE, Krishnagar.

An attempt has been made in the present paper to work out the origin of the genus *Saccharum* from phyto-geographical data, corroborated by morphological and cytogenetical evidences.

Distribution of *Saccharum* and its congeners shows that *Erianthus* has the highest number of species (28) and is most widely distributed in Asia, Euro.

and America. Majority of *Erianthus* occurs in India (particularly on the slopes and foothills of the Himalayas in Eastern India) and in America. *Saccharum* has 5 species occurring in India, Malaysia and China, the majority of which (4 sp.) occur in India. *Sclerostachya* has 3 species, 2 of which are found in India, and *Narenga* has 2 species, distributed in India, Indochina and China. Hence the maximum concentration of species belonging to these four genera is in India.

On the basis of phytogeographical, morphological and cytogenetical evidences, it is suggested that *Saccharum Complex* originated in Indo-Burma-Chinese region, wherefrom it spread to adjoining areas. It is quite likely that *Saccharum*, *Sclerostachya* and *Narenga* had common origin from *Erianthus*. It is significant that some species of *Erianthus* has the lowest chromosome number ( $2n=20$ ) in the *Saccharum complex*, and *E. procerus* (Roxb.) Mukherjee, *E. arundinaceus* (Retz.) Desw. and *E. elephantinus* Hook f., occurring in N. E. India, look very much like sugarcane in their robust culms. Further speciation in *Saccharum* might have taken place by polyploidy and hybridisation. Useful mutants as sweet forms had been perpetuated through clonal propagation by human selection, viz., *S. Barberi* in India, and *S. sinensis* in China; *S. robustum* had on the other hand evolved by natural selection in New Guinea. *S. officinarum* is also indicated to have originated in India, because origin of *S. Barberi* in India by hybridisation of *S. officinarum* with *S. spontaneum* pre-supposes presence of the former species in India from very early days.

#### 43. Contribution to the Embryology of two Boraginaceae.

J. VENKATESWARLU and B. ATCHUTARAMAMURTI, Waltair.

Embryology of *Coldenia procumbens* and *Heliotropium curassavicum* have been studied.

The floral whorls in *Coldenia procumbens* and *Heliotropium curassavicum* develop in an acropetal succession.

The anther in *Coldenia procumbens* and *Heliotropium curassavicum* shows in its structure epidermis, two wall layers, secretory type of anther tapetum of parietal origin surrounding the sporogenous tissue. The cells of the tapetum are binucleate. The division of the pollen mother cells is of simultaneous type. Cytokinesis takes place by furrowing. Both tetrahedral and bilateral tetrads are formed in *Coldenia procumbens*. Pollen grains are two nucleate at the time of shedding. They show three germ pores in the exine.

The ovule is unitegmic and tenuinucellate. It is hemianatropous in *Coldenia procumbens* and anatropous in *Heliotropium curassavicum*. A parietal cell is cut off in *Coldenia procumbens* and in *Heliotropium curassavicum* the nucellar epidermal cells divide periclinally. The inner most layer of the integument forms the endothelium. The archesporium in *Coldenia procumbens* is unicellular usually, while that in *Heliotropium curassavicum* is 3-4 celled. In both, only one functions further. A linear tetrad is formed in both the species. The chalazal megaspore of the tetrad is functional. An 8-nucleate embryo-sac is developed according to Polygonum Type. The egg apparatus in both plants shows typical characteristic structure in the egg and synergids. The synergids are hooked in both the plants. Antipodals disappear just before fertilisation in *Coldenia procumbens*, but they persist up to the first division of the endosperm nucleus in *Heliotropium curassavicum*. In *Coldenia procumbens* there is an obturator.

Fertilisation is porogamous.

Endosperm is of cellular type. Chalazal and micropylar haustorium are found in *Coldenia procumbens*. A chalazal haustorium is absent in *Heliotropium curassavicum*.

Embryo development has been studied in detail in *Coldenia procumbens*. It conforms to Chenopodiad type.



A comparison of embryological features of *Coldenia procumbens* is made with *Heliotropium curassavicum*, and other Boraginaceae and it is found that the embryological evidence does not support the view that *Heliotropium curassavicum* to be placed in a separate family.

**44. The range of variation in the number of Protoxylem Poles in the adventitious roots of a few Dicot plants.**

B. SAMANTARAI and S. K. SINHA, Cuttack.

The number of protoxylem poles is subject to much variation. Some information is given as to the extents of such variation in the adventitious roots of nine local Dicot plants, distributed over six different families. In all but one definite tendency towards polyarchy is marked. In two species some or most of the roots are truly polyarch. But seedling roots conform to typical Dicot structure with a few protoxylem poles. Taken in conjunction with the fact that polyarchy is a normal feature of Monocot roots such trends in the Dicot plants seem to be somewhat meaningful.

**45. Micrometry of Woolly Leaves of *Hyoscyamus muticus* Linn.**

B. GUPTA, Calcutta.

The wooly trichomes can be removed by flattening the leaves, and after drying, suitable pieces are cut out. The cut pieces should be uniform and should not contain main veins running along it. The cut pieces should be ground very lightly between two strips of "Sand Paper (No. "00")" in a way so as to leave only the bases of trichomes without injuring the epidermal layer.

From the whole and surface preparations of *Hyoscyamus muticus* leaves, following constants were obtained. Veinlet number 4·5-5·9-8·0; Veinlet termination number 7·75-11·25-15·25; Palisade ratio 3·5-5·3-6·5. Upper epidermis:—stomatal number 70-97·9-128; epidermal cell number 320-419·4-528; stomatal index 14·67-19·01-22·60. Lower epidermis:—stomatal number 96-126·6-176; epidermal cell number 464-577·4-528; stomatal index 15·25-18·07-23·01.

**46. The poral dehiscence of anthers in *Polygala*.**

C. S. VENKATESH, Delhi.

The paper deals with the structural peculiarities associated with poral dehiscence of anthers in four species of *Polygala*. The anther wall is thin and comprises the epidermis, hypodermis, a middle layer and the tapetum. Cells of the hypodermal layer and the dorsal part of the connective enlarge and acquire typical fibrous thickenings. A single median stomium is formed on the ventral face of the anther. It consists of the unenlarged and unthickened cells of the epidermis, hypodermis and the subjacent part of the connective. The stomium is incomplete, the anther being devoid of such an area in its lower part. Consequently only the upper part of the anther splits along the stomium. The split valves gape apart on account of the contraction of the fibrous cells thus giving rise to the single large pore. The lower part of the anther remains undehisced owing to the lack of a stomium, though, in this region also the fibrous thickenings are well developed.

Flowers of all the species investigated are regularly self-pollinated. The poral dehiscence of the anthers is considered to be advantageous for this process.

17. Morphology and embryology of *Ehretia laevis* Roxb.

I. K. VASIL, Delhi.

The bicarpellary, syncarpous gynaecium has a unilocular ovary with four anatropous ovules on two swollen parietal placentae. Sometimes, however, flowers may be 6- to 7-merous and occasionally the gynaecium may be tri- or tetra-carpellary with 6 and 8 ovules respectively.

The anther tapetum is secretory, multinucleate and 2-layered. In some abnormal cases the tapetal cells may elongate radially and protrude into the loculus. Reduction divisions are simultaneous and the spindles are often arranged in a tetrahedral fashion. Isobilateral and decussate tetrads are also formed. Polyspory—with 5, 6, or 7 microspores in a 'tetrad'—is common. The pollen is shed at the 2-celled stage and shows 8 ridges with one germ pore in each furrow.

The ovules are unitegmic and crassinucellate. The hypodermal archesporium may be one- to several-celled. A parietal cell is formed which undergoes an anticlinal division. In one case the two parietal cells had enlarged and become vacuolated simulating the appearance of functional megaspores. The megaspore mother cell gives rise to a dyad of megaspores and usually the lower dyad cell produces the embryo sac. The female gametophyte thus conforms to the *Allium* type. Occurrence of bisporic embryo sacs in the Boraginaceae has also been reported in *Lycopsis arvensis* and *Anchusa officinalis* (Svensson, 1925). In all the other species investigated so far, except *Cynoglossum amabile* (Millsaps, 1940), which needs reinvestigation, the embryo sac is of the Polygonum type.

The endosperm is probably Cellular and micropylar and chalazal haustoria are formed. The peripheral endosperm cells show aggressive activity and digest the entire integument except its epidermis. The embryo development is of the Crucifer type. The fruit is a fleshy, 4-lobed drupe and contains 4 seeds. The pericarp is differentiated into a thin epicarp, fleshy and starchy mesocarp, and stony endocarp. The seed has a single layered testa which is the much lignified outer epidermis of the integument. Two to three layers of fatty endosperm persist in the seed. The embryo is dicotyledonous, fleshy and curved.

48. Floral Morphology and Embryology of *Nuytsia Floribunda* (Labill.) R. Br.

R. NARAYANA, Delhi.

Unlike all other members of the Loranthaceae, which are stem parasites, *Nuytsia floribunda*, a West Australian tree, is a root parasite. The sessile flowers occur in stalked groups of three on a racemose inflorescence. The central flower of the triad is bisexual but the laterals are staminate with stylodes. The former alone develops into a three-winged, sub-drupaceous fruit.

The inferior ovary bears a 5 to 6 toothed calyculus which shows a distinct vascular supply. The latter feature supports the view that the calyculus represents a reduced calyx and is not an "axial structure" as held by Engler (1889, 1935), and Schaeppi and Steindl (1942).

The young ovary encloses a stalked "mamelon" which elongates up to the base of the style. In its basal region the ovary shows 3-chambered condition due to the lateral fusion of the mamelon with the ovary wall in between the lobes. The upper part of the mamelon, which shows vascular elements, remains free from the wall of the ovarian cavity. A multicelled hypodermal archesporium differentiates in each of the three basal lobes. Several of these enlarge, become spindle-shaped and develop into megaspore mother cells without the formation of any parietal tissue. Linear tetrads are formed. Six to seventeen embryo sacs grow simultaneously. Their upper ends, each with two nuclei, extend beyond the mamelon and come to lie one above the other in the stylar canal reaching up to about two-thirds its length. The lower ends of the embryo sacs grow down as



far as the base of the collenchymatous tube. The two nuclei at the tip divide twice to form the quartet which organizes into the egg apparatus and the upper polar nucleus. The upper end shows a lateral, tubular process which is directed towards the wall of the style. The fate of the nuclei in the lower end is under investigation.

In older flowers the primary endosperm nucleus comes to lie at the lower end of the embryo sac. The endosperm is cellular and endosperms of several embryo sacs fuse to form a composite structure. In cross section this is tri-radiate and devoid of grooves or lobes. Three to five biseriata proembryos descend into the endosperm but only one attains maturity. The three-winged fruit develops a thin layer of viscid tissue.

The arborescent habit of *Nuytsia floribunda*, its root parasitism, presence of a vascular supply in the calyculus, mamelon with vascular traces and multicellular archesporium in each of its three basal lobes are features of special interest which have not been reported hitherto. These findings strengthen the belief that the Lorantheae may have been derived from the Santalaceae.

#### 49. Contribution to the Embryology of *Duranta Plumieri* Jacq.

J. K. MAHESHWARI, Delhi.

The family Verbenaceae has not received adequate attention from an embryological point of view. The present study on *Duranta plumieri* deals with the male and female gametophytes, the endosperm and embryo development.

The archesporium in an anther comprises a hypodermal group of 12-14 cells in transverse section and 18-20 cells in longitudinal section. The tapetum is glandular and the nuclei fuse to give rise to polyploid masses. During meiotic divisions, the mother cells are arranged in an arc-shaped manner. The reduction divisions are simultaneous and quadripartition occurs by furrowing. Isobilateral tetrahedral and decussate tetrads are produced. The pollen is shed at the 2-cell stage.

The ovules are unitegmic, tenuinucellate and become completely anatropous by the time the megaspore mother cell is formed. Three to six hypodermal archesporial cells differentiate in the young nucellus. Two to three function as megaspore mother cells, but it is usually the uppermost mother cell alone that gives rise to a tetrad of megaspores. Occasionally, some nucellar cells simulate the appearance of megaspore mother cells. The development of the embryo sac is of the Polygonum type. Some abnormalities in the organisation of the embryo sac have been observed.

The first division of the primary endosperm nucleus is followed by a thin transverse wall giving rise to the primary chalazal and the primary micropylar chambers. The nucleus of the former divides twice without any wall formation and functions directly as the chalazal haustorium. The latter usually remains 4-nucleate. The micropylar chamber divides by a longitudinal wall, thus following the Brunella type of endosperm development. Due to widespread degenerations, the further sequence of divisions could not be followed. In any case, the micropylar haustorium shows several tiers of cells. Due to its activity, the adjacent integumentary cells are depleted of their contents. In advanced stages, 4-6 tiers of endosperm cells adjacent to the chalazal haustorium also become active and show denser cytoplasm. They probably help in conducting nourishment from the chalazal haustorium to the endosperm proper. In addition the peripheral layers of endosperm cells become active and divide to produce radial rows of 3-5 cells.

The first division of the zygote is transverse. The terminal cell divides vertically while the basal divides transversely. The development conforms to the Crucifer type.

## 0. Megasporangium, Megasporogenesis and Female Gametophyte of *Mimosa Rubicaulis*, Lamb.

B. N. MULAY and B. S. SHAMI, Pilani.

1. Ovules are anatropous and have two integuments; micropyle is formed only by the outer integument.
2. Primary archesporium is hypodermal, and more than one megaspore mother cells, and rarely two tetrads were also seen in one ovule.
3. The parietal tissue is very large and is partly contributed by multiple epidermis.
4. Rarely the primary sporogenous cell may divide before undergoing reduction division.
5. A linear row of tetrad was found with chalazal megaspore functioning. Embryo sac was of normal type.
6. Synergids are hooked and persist for some time even after fertilization.
7. Antipodals are robust and persist till fertilization.
8. Starch grains were abundant in the embryo sac which their maximum development just before fertilization.
9. The first division in the oospore is transverse and the endosperm nucleus divides just before the division of the oospore.
10. It is concluded that Mimoseae is relatively more primitive than Papilionaceae.

## ECOLOGY AND PLANT GEOGRAPHY

### 51. Root System of *Gynandropsis pentaphylla* DC.

SHANTI SARUP and S. K. TONDON, Jodhpur.

The study of the root system of *Gynandropsis pentaphylla* DC. throws light on the co-relation of root development to the nature of the soil and available water supply. Generally the tap root of mature plant in sandy locality goes up to 2½ feet deep in the substratum. The finer rootlets are given out deep in the substratum. This may be correlated with the deep water table in sandy areas and easy penetration into the soil due to its coarse texture.

In the gravel the roots of the plant give abundant rootlets even just below the surface of the substratum. This is thought to be caused by the coarse texture of the substratum. Moreover profuse development of the root system is due to the scarcity of water and good aeration of the soil. In clayey soil the roots are less developed and penetrate the substratum to lesser extent than in sand or gravel. This may be due to the fact that the soil is compact and the available water supply is favourable in the soil.

It was also noted that in scanty water supply the development of the roots is more elaborate than those of plants which are growing in ample water supply.

### 52. Habits of Weeds of Jaswant College Compound, Jodhpur.

PROF. SHANTI SARUP and BRIJMOHAN, Jodhpur.

### 53. Humus Content of Mangrove Soils of Bombay and Salsette Islands.

B. S. NAVALKAR, Visnagar, N.G.

While studying the Ecology of Mangroves of Bombay and Salsette Islands, it was thought fit to pay attention to the humus content in the analysis of the soil. The physical and other chemical aspects of the soil have been worked out in the



previous papers by the author. In spite of favourable environment for the humus to accumulate due to water-logged condition and consequent poor aeration of the soil, it is interesting to note that the mangrove soils do not accumulate too much of humus.

This could be seen from the results which show the humus content of Avicennia soil. It is further observed that the humus content is minimum in the rainy season (1.25%) as compared with hot (1.48%) and cold (1.61%) seasons. The lowest values in monsoon, are probably due to the fact that there are greater chances of decay and decaying superficial organic matter to be washed away by rains and floods than washing away only by the tides as in other seasons.

The slight higher values of humus content of Avicennia over the other mangroves may be responsible for another additional factor in causing the dominance over other marshy plants.

#### 54. Contribution to our Knowledge of the Physiological Anatomy of Some Indian Hydrophytes.—II. The Stem of *Eclipta alba* Hassk.

M. V. MIRASHI, Nagpur.

*Eclipta alba* Hassk., a member of the family Compositae, is the only species of the genus *Eclipta* occurring in our country. The author has observed it growing as a marsh plant in Nagpur. Anatomical investigation of the stem of this species has confirmed its hydrophytic nature.

The stem shows significant anatomical differences in the aerial and submerged parts. Absence of cuticle, raised position of the stomata, presence of an extensive lacunar and chlorenchymatous cortex and the formation of lenticels in the submerged parts indicate that the stem is well adapted to a marshy habitat.

These and some other characters of the stem of this hydrophytic form stand in strong contrast to those described earlier by Sabnis for a xerophytic form of *Eclipta alba* Hassk. occurring in the Indian Desert.

Attention is drawn to the physiological significance of occurrence of anthocyanin pigment in the epidermal cells. The physiological importance of discovery of hydrophytic members among Compositae is briefly referred to.

#### 55. The Vegetation of Glacial Moraines of the Pindari Glacier, Kumaun, India.

S. SINHA, Agra.

The area under study lies at an altitude of 1200-14000' above the sea level and consists mainly of glacial moraines which remain covered with snow for 9 months in the year. The moraines form the outer southern boundary of the perpetual snow line. These morainic deposits are not completely colonised by vegetation and bare areas of protruding rocks, stones and clayey soil are common.

The plants are adapted to xerophytic conditions due to hard, shallow and poor soil with a low temperature, thereby creating physiological dryness. The flora consists chiefly of angiosperms, mainly the dicots. Monocots are fewer and restricted to favourable localities. Dicots are represented by 26 families, 58 genera and 82 species out of a total number of about 100 species. *Ephedra gerardiana* is the only *Gymnosperm* represented in the area. Higher Cryptogams are remarkably few being represented by two ferns and *Equisetum arvense*. Some Lichens and mosses are common.

The tree limit is reached on the southern outskirts of the tract at a little over 10,000' where an association of *Rhododendron barbatum* is found.

**56. Biological Spectra of 8 Grassland Associations near Sagar, M.P.**

S. C. PANDEYA, Jabalpur.

Grasslands of Sagar, Madhya Pradesh have been divided into 8 associations and have been named after the dominant species as under :—1. *Themeda caudata*, 2. *Eulalia trispicata* and *Cymbopogon martini*, 3. *Setaria nervosa* and *Tripsacum daniellii*, 4. *Bothriochloa pertusa*, *Dichanthium annulatum* and *D. caricosum*, 5. *Heteropogon contortus*, 6. *Aristida adscensionis* and *Melanocenthrus cenchroides*, 7. *Coix lacryma-Jobi* and *Ischaemum rugosum*, 8. *Cynodon dactylon*, *Bothriochloa pertusa*, *Dichanthium annulatum* and *D. caricosum*. The paper includes the study of the Raunkiaer's Biological spectra of these grassland associations in order to determine the intensity of grazing by this method.

The climate of Sagar actually supports a mixed dry deciduous type of forest since the rainfall is sufficiently high and water is stored up in the soil for absorption by deep rooted plants. The present status of the grasslands is so maintained by anthropogenic factors. Following conclusions have been drawn after a close study of the biological spectra of all the associations :—

1. The highly therophytic character of the grasslands is undoubtedly due to strongly periodic climate and grazing which maintains the communities open for further invasion of therophytes.

2. But the significant life-form of the grasslands are hemicryptophytes and the geophytes as these growth forms are maintained solely on account of the degree of grazing.

3. Further increase in the soil moisture brings about an increase in hemicryptophytes.

4. Intensive grazing results in the decrease of both hemicryptophytes and geophytes.

5. Release in the biotic operations results in the increase of chaemaphytes.

**57. Notes on Autecology of *Iseilema Anthephoroides* Hack.**

S. C. PANDEYA, Jabalpur.

The paper deals with the autecology of *Iseilema anthephoroides* Hack., belonging to tribe Andropogoneae and family Gramineae. It is a much tufted perennial grass, branching freely, and very leafy below with many stems. The species is found all over India but is frequent in Deccan Peninsula and Madhya Pradesh. This study was prosecuted at Sagar, M. P., where this species is widespread in wet localities.

Morphology of the species has been described.

It has a low reproductive capacity, being 134.27, and the seeds are not light (wt. of one seed—0.987 to 1.142 mgm.). The seeds are broad and lanceolate in shape—average length 1.65 mm., average breadth 1.05 mm. With glume, in which condition it is dispersed, the length average is 4 mm. and breadth is 1.16 mm. Seeds are mainly wind dispersed.

The species grows on moist soils which are mature to premature. Soil has been analysed in detail. Soil moisture appears to be one of the decisive factors for the growth of the species. Growth of the plants has been noted from a number of localities having different soil moisture. Variation in soil moisture has been found to be 5.8 to 26.6%, the optimum being 22.26%. Culture experiments show that the species does not stand water-logging.

Restricted soil requirements and low reproductive capacity have been discussed to be responsible for restricted distribution of this species.

The grass has been classed as a good fodder grass,



## CYTOGENETICS AND GENETICS

58. Cyto-taxonomical studies on the *Cyclosorus parasiticus* complex and the *Asplenium aethiopicum* complex.

G. PANIGRAHI, Cuttack.

Cytotaxonomical investigation of a portion of the *Cyclosorus parasiticus* complex has been useful in sorting out six taxonomic species together with two varieties. Of these, the only diploid *C. repandulus* (v.A.v.R.) Ching together with four of the tetraploids came from Ceylon. Of the remaining three tetraploids, two came from Malaya and one from Madeira. The diploid species forms 36 bivalents during sporogenesis in contrast to the 72 bivalents formed in each of the seven tetraploids.

Four different triploid  $F_1$  hybrids and three tetraploid  $F_1$  hybrids were artificially synthesised by crossing the diploid species with four of the tetraploids and three of the tetraploids with each other, respectively.

Studies of meiosis together with the morphological features of the seven  $F_1$  hybrids indicate that the diploid species or one with similar homology of chromosomes is partly ancestral to five of the tetraploids, which are, therefore, probably amphidiploids. The diploid species appears to be relic of the past.

Further, the genetical relationships of three cytotypes of the *Asplenium aethiopicum* complex, viz. tetraploid and octoploid from Kenya and dodecaploid from Madeira have been elucidated on the basis of chromosome pairing in the  $F_1$  hybrids between them. *A. aethiopicum* agg. has been established as an old polyploid complex.

59. Cytogenetical Investigations of X-ray induced mutations in Jute (*Corchorus Olitorius* Linn.)

R. M. DATTA and G. I. PATEL, Barrackpore.

The dry and moist seed of *C. olitorius* (var. 040-632) were treated with eight different dosages of X-rays. The germination particularly of the seeds treated with higher dosages were observed to be slow, which may be due to mitotic inhibition as a result of chromosome breakage. The highest dosages of 30000 and 40000r units employed on moist and dry seeds respectively were found to be much below the lethal dose. The various morphological characters observed in the mutants studied herein were not noticed in their X-2 generation. In fact, in the population of one of the mutants (No. 4), a new mutant form was observed.

At late diakinesis, 7 II+0 to 2 fragments, 5 II+1 IV+0 to 3 fragments and 3 II+2 IV+0 to 3 fragments were observed. One to two bivalents along with one or no fragment or a quadrivalent, as the case may be, were found attached to the nucleolus. The quadrivalent formation indicates the presence of reciprocal translocation which must have resulted due to the union of broken pieces—acentric chromosome piece with a centric one—of non-homologous chromosomes.

At metaphase I, one to two chromosome pairs were found lying on the spindle and away from the metaphase plate. The chromosomes of the pair or pairs concerned could not separate and eventually go to one pole. The sticking behaviour of the chromosomes of the pair or pairs concerned may be due to certain changes in their structure particularly in the centromere.

Various combinations of bridge-fragment associations were observed at anaphase I. One to three bridges were noticed accompanying with or without fragments. The bridges break mostly in the centre by the end of telophase I. The broken bridges having connections with the nuclei seem to get withdrawn in them. Two small dot shaped fragments of just about the same size and lying opposite to each other a little distance apart and with or without a membrane around them were com-

monly noticed in cytoplasm. They are more likely to have been derived from a large dot shaped chromosome fragment.

The fragments of different size were observed mostly lying in cytoplasm in various stages of both the meiotic divisions. Tetrad analysis shows that the majority of them have normal number of microspores in all the mutants. The number of p.m.c's recorded with and without fragments in various stages of both the meiotic divisions in two mutants (No. 4 and 5) suggests while comparing with their tetrad analysis that the majority of the fragments get degenerated in cytoplasm.

#### 60. Genetic Investigations of the 'Whorled' Mutant in *Gossypium herbaceum*.

N. R. BHAT and N. D. DESAI, Surat.

The 'Whorled' mutant in *G. herbaceum* found at the Agricultural Research Station, Surat, Bombay State, was crossed with three herbaceum types developed at the Station, viz., (1) 8-1 Red, (2) ghost spot, white flower, 4-5 loculed Triple Recessive and (3) Cluster-Short Branch, ghost spot, white flower, 4-5 loculed, lintless Quintuple Recessive, for genetic investigations. The  $F_1$  characters for Branching Habit and Boll Loculi Number indicated complementariness of parental characters as described below:—

Parental characters.

Cluster-Short Branch  $\times$  Whorled.

4-5 loculed  $\times$  2-3 loculed, both individually recessive  
to 3-4 loculed.

$F_1$  characters.

Normal.

3-4 or 3-2 loculed.

In regard to other characters, the usual allelic relationships were observed.

436, 80 and 157  $F_2$  plants respectively from the above three crosses were studied. The segregations in the crosses with the Quintuple Recessive and Triple Recessive types were disturbed due to about 33 per cent deficiency in viability of the Ghost Spot segregates. The cross with 8-1 Red herbaceum type revealed a linkage of 11.6 R.P. between the  $R_2$  and Whorled ( $cl_2Wh$ ) loci. The cross with the Quintuple Recessive indicated a linkage of 29 R.P. between  $R_2$  and Cluster-Short Branch ( $cl_2BH$ ).

A three point test showed that the  $cl_2Wh$  and  $cl_2BH$  loci are situated on either side of the  $R_2$  locus, the observed data showing good agreement with the expected 36.5 R.P. between them.

The locus for 2-3 boll loculi number,  $loc^{2-3}$  was found to be fully linked or identical with  $cl_2Wh$ . The locus for  $loc^{4-5}$  which is complementary to  $loc^{2-3}$  seems to be very closely linked with it. The R.P. between the two could not be estimated due to the deficient viability of ghost spot segregates. Modifier influenced the expression of this character.

#### 61. Studies on the influence of Vernalization on the Mitotic behaviour of *Allium cepa*, Linn. (Bellary Onion) and *Allium sativum*, Linn. (Garlic).

K. RANGASWAMI, Annamalainagar.

Previous work in this laboratory has shown that *Allium cepa*, Linn. (Bellary Onion) and *Allium sativum*, Linn. (Garlic) could be successfully vernalized. The result of vernalization was striking in that the yield was larger, and there was a conspicuous increase in the size of the vernalized bulbs. (Pannirselvam, 1954). The present investigation was undertaken with a view to study the possible influence of vernalization on the mitosis of *Allium cepa*, Linn. and *Allium sativum*, Linn. The bulbs were subjected to 7°C for 25 days and then they were planted for this purpose.



The low temperature has been found to inhibit considerably the formation of the achromatic figure. Consequently the mitotic division became irregular. The following significant mitotic aberrations were observed: (1) alteration of chromosome numbers in the divided nuclei due to unequal distribution of chromosomes; (2) disparity between the sizes of the daughter nuclei; (3) promiscuous scattering of chromosomes within the cell; (4) precocious organization of irregularly shaped nuclei enclosing more than the normal diploid number of chromosomes and bearing superficial resemblance to amitotic configurations (pseudoamitosis).

The possibility of low temperatures exercising far reaching influence on the process of mitosis so as to bring about doubling of the chromosome numbers and producing permanent polyploids of the true breeding type, has been indicated.

## 62. Differentiation and Dedifferentiation in Yeasts.

T. R. THIAGARAJAN, Bangalore.

During growth as a giant colony, yeast cells exhibit ascending grades of nuclear complexity. Photomicrographic evidence is adduced to show that when such endopolyploid cells are stimulated by transfer to fresh media, they rapidly lose their complexity by repeated cytokinesis in the absence of any chromosome reproduction. The nucleus can, therefore, be said to exhibit *differentiation and dedifferentiation*. The nuclear events during dedifferentiation are an exact reversal of those observed during differentiation. Yeasts are lowly organised forms and as such endopolyploidy as well as the phenomena of nuclear dedifferentiation observed appear to be adaptive mechanisms enabling survival under a variety of environmental conditions.

## 63. An additional evidence for the presence of the genome of *Aegilops squarrosa* in the hexaploid wheats.

R. P. ROY, Patna.

Several hybrids of 42-chromosomes intergeneric amphidiploids of *Triticum* and *Aegilops* with some species of the hexaploid wheats were raised. Most of the hybrid combinations had normal plants; however, one group of amphidiploid hybrids involving the amphidiploid (*T. dicoccoides* × *A. bicornis*) and *T. aestivum* or *T. spelta* were inviable. Most plants of the inviable hybrid combinations died and the reciprocal crosses gave exactly the same result. The surviving plants were also reduced in vigour and had only one or at the most two weak tillers. They were completely sterile.

Large number of other crosses were then made involving the amphidiploid (*T. dicoccoides* × *A. bicornis*) as one parent and several other intergeneric amphidiploids of *Triticum* and *Aegilops* species as the other. These crosses were made with a view to find out the probable cause of inviability as reported in the above set of crosses. The behaviour of these hybrids indicate that the inviability was presumably associated with the genome of *A. bicornis* and DD genome of the hexaploid wheats and not with the AABB genomes of *T. dicoccoides* and the bread wheats. Meiosis in the viable and inviable hybrid plants was as normal as could be expected on the basis of chromosome constitution. Due to sterility no genetic basis of inviability could be determined. However, inviability in these amphidiploid hybrids presumably due to some sort of interaction between the genome of *A. bicornis* and DD genome of bread wheats has been compared to other cases of inviability in hybrids reported by other workers. It has been pointed out that the inviability factors might have arisen either accidentally in the two species or as an isolation mechanism. One point, however, is very significant. The appearance of inviability in hybrids of (*T. dicoccoides* × *A. bicornis*) with either the hexaploid

seats or with other amphidiploids containing the genome of *A. squarrosa*, and not with the amphidiploids containing the genomes of other species of *Aegilops*, indicates that the DD genome of the hexaploid wheats are derived from *A. squarrosa*. This is thus an additional evidence which supports the conclusions of other workers at the third i.e. the DD genome of the hexaploid wheats has been donated by a diploid species *A. squarrosa*. This type of study is comparatively a new approach to understand the origin of species in the past.

#### 14. Naturally occurring Triploid, Tetraploid and Pentaploid *Lantana camara*.

NIRAD K. SEN and V. M. SAHANI, Kharagpur.

*Lantana camara* Linn. of the fam. Verbanaceae is an American plant which has become wild in India growing luxuriantly throughout the country. Cytological studies have revealed presence of a polyploid series in the natural populations of this locality, the tetraploids being the dominant type. The morphological differences were not conspicuous enough to distinguish one type from the other, but they could be identified on the basis of their chromosome numbers and pollen sterility. The triploids had 33 chromosomes mostly forming trivalents; the tetraploids had 44 chromosomes mostly as bivalents; and the 55 chromosomes of the pentaploids also formed a large number of bivalents; though trivalents, tetravalents and occasional pentavalents were common. Pollen of the triploids were shrunken, the sterility in tetraploids and pentaploids being 50% and 80% respectively. Fruits are seen on triploid and pentaploid types and all the three types can propagate vegetatively.

Though diploids are yet to be found in this locality, presence of plants with 22 chromosomes have been reported by Singh (1951). It is assumed that polyploidization and apomictic propagation have played an important role in the success of *Lantana camara*.

#### 15. Meiotic Abnormalities and Chromosome number in *Bougainvillea*.

NIRAD K. SEN and SUBIR SEN, Kharagpur.

*Bougainvillea*s with their attractive coloured bracts are favourite garden plants. Cooper (1931) observed 10 pairs of chromosomes in *Bougainvillea glabra* and in the variety "Crimson Lake" probably of *B. spectabilis* or of *B. buttiana*. In both the plants meiosis was normal.

*Bougainvillea* varieties growing in this campus were found to have 32 chromosomes and meiotic abnormalities due to their irregular pairing. In a variety with carmine red bracts and large flowers the 32 chromosomes were seen to form 8-12 bivalents and the remaining chromosomes were present as univalents. Often trivalents were seen and occasionally one of the configurations seemed to be a quadrivalent. Meiotic abnormalities like precocious movement of chromosomes at metaphase, laggards at anaphase, non-inclusion of chromosomes in the tetrads and subsequent formation of micronuclei were common features. Most of the pollen are sterile and the plant is propagated by cuttings. The plant resembles *B. spectabilis*, wild closely in the presence of hairs, alternate leaves and colour of bract. The same number of chromosomes was observed in three other types studied, but with considerable difference in the frequency of meiotic abnormalities, and in one type most of the diakinesis cells had 16 bivalents.

#### 16. Study on Karyotype of Common Pulses.

NIRAD K. SEN and A. K. GHOSH, Kharagpur.

Chromosome morphology of the common pulses were studied from metaphase plates of root tips treated in coumarin, squashed and stained in aceto-orcein. The



number of chromosomes in the pulses is low ranging from 14 to 24, except soyabean. On the basis of chromosome size, the pulses may be divided into groups: (i) those having small chromosomes like gram (16), green gram (16), black gram (22), pigeon pea (22), cowpea (24) and soyabean (40); and (ii) those having large chromosomes like lentil, pea and grass pea all with 14 chromosomes. In all the pulses, the chromosomes have sub-median primary constriction and there are at least two pairs of chromosomes with prominent secondary constrictions. In the small chromosome group all the pulses have a conspicuously small pair of chromosomes, there being three such pairs in soyabean. The pulses of the large chromosome group have several common features in having (i) weak stem tendrils, (ii) same number of chromosomes, which is minimum in this heterogeneous group, (iii) a pair of chromosomes with secondary constriction located close to the primary one, and (iv) another pair of chromosome with supernumerary secondary constrictions.

#### 67. Heterocyclic bases—an aspect of their use in Cytochemistry.

A. K. SHARMA and DEEPESH DE, Calcutta.

The present paper has dealt with the effect of the chemicals, viz., *Guanine*, *Uracil* and *Maleic hydrazide*, the structural isomer of Uracil, on the somatic tissues of plants. In order to generalize the inferences, both monocotyledons and dicotyledons were subjected to experiments. Short treatments upto 6 hours and long ones upto 48 hours followed by recovery upto 120 hours have been performed. Concentrations in all these cases have been started from extremely low to high ones. The time, temperature as well as the concentration required for a particular chemical to affect plants vary in different species. So far as Guanine and Uracil are concerned, it has been demonstrated that treatments in a particular concentration for a specified period can bring about the details of the chromosome structure. This concentration has also been found to lie below the one necessary for causing subnarcotic effects. Cold temperature has been found to be an essential factor in the operation. In addition to such specialized property of causing chromosome clarification, certain other interesting peculiarities have also been worked out. The fate of the fragments resulting after certain period of treatment has been followed and in most of the cases found to degenerate after certain period of recovery. Formation of micronuclei are further found to be a common feature in Guanine and Uracil fragmentation. In case of Uracil, subnarcotic effects have been brought both instantaneously and later after a certain period of recovery. The causes of differential effects on different chromosome segments as well as delayed effects have been discussed. In bringing about the delayed effect, the capability of the penetration of the chemical and the possibility of their accumulation has been found to be an important factor. The response of different chromosome segments to the chemical concerned has been suggested as a reflection of their chemical differences. Further, the difference in time taken for the manifestation of the effect in excised and intact root-tips has been regarded as a significant point for consideration. The causes of such differential behaviour have been discussed. It has been emphasized that these chemicals can easily be employed in technique for the study of chromosome analysis as pretreatments before fixation in hot dye-acid mixture.

#### 68. Polyploidy in *Dioscorea*.

A. K. SHARMA and DEEPESH DE, Calcutta.

Bulbils of *Dioscorea* of different species and individuals were collected and grown in the garden. Somatic number was found out following Feulgen squashing technique.

*Dioscorea sativa* has a chromosome number of  $2n=40$  and *D. alata* has a polyploid series of 30, 40, 50 and 70 chromosomes in different individuals. Satellite bunts were also taken.

Certain individuals of *D. alata* revealed the presence of different chromosome numbers, viz., 38, 52, 55, 66 in the somatic cells of the same individual.

Meiotic divisional stages were only obtained in *D. sativa* showing clear 20ivalents.

Significance of a polyploid series in the same species and different chromosome numbers in the same individual from the point of view of speciation, specially in plants propagating mainly through vegetative means has been discussed.

### 39. The Scope of Orcein staining in the study of the effect of Chemicals on Chromosomes.

A. K. SHARMA and Miss MIRA ROY, Calcutta.

Widely different plant materials belonging to both dicotyledonous and monocotyledonous groups were subjected to chemical treatments involving Alloxan followed by Coumarin, Phenols, Oxyquinoline etc. for 3 to 4 hours both in cold as well as in room temperature. All the different sets were then hydrolysed in dye-acid mixture for 10, 20, 30 and 40 seconds and observed after mounting in 1% orcein. Well clarified metaphase plates were obtained after 10 seconds of heating, whereas in those of 20 and 30 seconds, considerable erosion and fragmentation of chromosomes were recorded respectively. Absolute disappearance of the stain could be noted after heating for 40 seconds in the mixture. That the fragmentation is caused only by the orcein molecule under heated conditions, is brought out from a series of controls checking all the variables under operation. Pre-treatment in chemicals has been found to be of absolute necessity of breakage, as evidenced by the absence of any fragments after direct treatment. It has been suggested that the treatment in chemicals before heating causes depolymerisation of highly condensed DNA molecules, at the same time resulting into lability of nucleoprotein linkage at certain segments. Subsequent heating results absolute detachment of DNA molecules from the protein thread at specialised segments, manifested by erosion of chromosome regions. As a consequence, these regions being devoid of any matrix become exposed to the action of molecules of orcein, and liable to breakages. Of all the chemicals tested for pre-treatments marked positive results were obtained after Alloxan treatment for 1 hour followed by treatment for 2 hours in Coumarin solution at  $12^{\circ}$  to  $16^{\circ}\text{C}$ . Phenols too yield satisfactory result. The other chemicals tried need slightly more treatment for demonstration of chromosome breaking activity. The principal literature on this subject has been discussed and the procedure followed in most of these studies have been mentioned. As Feulgen preparations show no such effect, that technique has been recommended for such studies.

### 70. Induction of Chromosome Division through Ascorbic Acid Treatment.

A. K. SHARMA and ARUNABHA DUTTA, Calcutta.

Ascorbic acid has been used to induce chromosome division in the permanent cells. It has been observed that a number of polyploid cells which can be seen in control slides, when treated with ascorbic acid, show the initiation of division. The cause of this initiation has been suggested to be due to an increase in nucleic acid synthesis. The absence of division in polyploid cells is due to deficiency of nucleic acid. The application of vitamin plays a direct or indirect role in the synthesis of nucleic acid. Reduction division and haploid number in normal diploid cells have been found. Increase in synthesis of nucleic



acid responsible for initiating division in polyploid cells also causes reduction of division of normal diploid cells. Several abnormalities in chromosome structure including stickiness, chromatid breakage, chromatid bridge, lagging and multipolar nuclei have been observed. All these abnormalities can be accounted for on the basis of viscosity changes caused in the plasma. It is to be noted that none of the fixatives have been employed for chromosome precipitation, and the purpura being served after treatment by heating in dyeacid mixture.

#### 71. Effect of Irradiation on Embryonic Cells.

A. K. SHARMA and RAMEN MUKHERJI, Calcutta.

Dried bulbs of *Allium cepa* were exposed to irradiations of two different dosages namely 250r and 1000r with a view to observe the effect of irradiation on normal embryonic cells as well as the resting polyploid ones. Subsequent to irradiation the treated bulbs were transferred to different nutrient media namely nucleic acid solution; a mixture of base, sugar, and phosphate, and the sugar alone. The observations which continued upto 168 hours of irradiation revealed that the affected normal cells, though showing various abnormalities, still had a tendency to become normal after a period of 168 hours of irradiation, and which was further supported by a sharp reduction in their frequency. It has been noticed that irradiation may affect early embryonic cells which start dividing even after seven days of irradiation. The resting polyploid cells on the other hand, under the influence of irradiation, underwent such a tremendous deficiency in nucleic acid metabolism, that even a constant supply of nucleic acid from without, was unable to meet up the same which was evidenced by the complete suppression of their division in the media, otherwise permitting the diploid cells to divide profusely. Reduction of division has been found to be induced along with this.

#### 72. Plant Chromosomes and Related Cell structures—their Chemistry.

A. K. SHARMA and Miss MIRA ROY, Calcutta.

The present report has dealt with the phosphatase activity of different cellular constituent as revealed after treatments in different fixing chemicals both metallic and non-metallic. After a study of differential precipitation in different fluids the best preservation of cell structure in terms of phosphatase activity is obtained in Oxyquinoline, phenol and chromic formalin mixture. After fixation of root tips in suitable fixatives, different tests have been applied including Gomori's method for alkaline phosphatase, extraction of nucleic acids by trichloroacetic acid, as well as digestion by pepsin and trypsin, for the interpretation of chromosome, nucleolus and cytoplasmic structure. The following conclusions have been arrived at. The main thread of the chromosome is composed of a non-basic protein, surviving after tryptic digestion preceded by acid treatment, but not after digestion by pepsin. This is also rich in phosphatase activity hitherto unrecorded for. Discontinuous segments of basic proteins digestible by trypsin following previous treatment, over this ultimate fibre possibly associated in heterochromatic regions which all show high phosphatase activity. Final envelope is the nucleic acid removable by acid extraction and forming the mantle of the chromosome. The thread in the constriction region, both primary and secondary similarly is composed of non-basic proteins showing high phosphatase activity. As regards the nucleolus, the hyaline perinucleolar zone, the evidences show is composed of a substance resistant to acid extraction and enzymatic digestion. The intranucleolar matter is composed of both types of proteins in addition to RNA and also possibly contains phospholipides. The amount of non-basic protein is found to be maximum here. Phospholipides resistant to acid extraction and enzymatic digestion are present.

in the form of granules. As regards the constituents of cytoplasm, both types of proteins and nucleic acids are detected. The comparative amount of non-basic protein furthermore is maximum. Complex phospholipides are absent here though simpler forms might be present.

A review has been made of the principal cytochemical works up to now attempted on chromosome structure and the conclusion arrived here compared with the data of the previous works on both plant and animal chromosomes. Cytochemical researches on the salivary gland chromosome of *Drosophila* has been suggested to form an independent line of investigation in itself, not to be strictly applied to chromosome structure of somatic and germ cells.

### 73. Vitamins—their Property of Inducing Chromosome Division in Permanent Cells.

A. K. SHARMA and (Miss) BIBHA BHATTACHARYYA, Calcutta.

The growth promoting substances tried in the present work consists of four different chemicals, namely, Nicotinic acid, Succinic acid, Thiamine and Calcium pantothenate.

The chemicals have been tried for the induction of Chromosome division in permanent tissues. The test has been performed on the bulbs of *Allium cepa*. For confirmation of results in some cases sp. of *Hydrilla* were subjected to treatments.

The experiments have been conducted both in room as well as in cold temperature and effects had to be noted following different period of treatment starting from 2 hours to 6 hours. In some cases even after 24 hours or after some consecutive days the effects have been observed. In cases where recovery experiments were performed the effects were followed at intervals of 24 hours for consecutive four days and in some cases for few more days.

The polyploid differentiated cells lying in an incompletely divided state have been induced to divide by vitamin introduction. Consequently a number of polyploid cells in dividing conditions is seen in the tissue. At the same time the normal cells which divide mitotically can pass on to a reduction phase through the introduction of certain vitamins. There is then the occurrence of fragments in the polyploid cells—which are present in maximum frequency during the prophase stage being persistent through succeeding metaphase as well as anaphase stages. The stickiness is also observed in all the cases—which can be accounted for the late separation of genes and unbalanced behaviour of polytene threads during induction period.

The cause and significance of the phenomenon of induction of division in polyploid cells and the induction of reduction division in polyploid and normal cells have been discussed in detail. The emphasis has been given on the nucleic acid balance of the cell. The polyploid differentiated cells have been induced to divide by meeting up the nucleic acid deficiency indirectly brought about through vitamin introduction. Thus they have been also induced to pass on to a reduction phase.

### 74. Veratrine—Its use in Cytochemistry.

A. K. SHARMA and S. K. SARKAR, Calcutta.

The present investigation deals with a study of the properties of Veratrine in affecting cell structures necessary both from fundamental and economic standpoint. C-mitotic property of Veratrine has been demonstrated. Its capability of bringing out the details of chromosome structure, through a change in plasma viscosity and differential contraction of chromosome segments has further been brought out.



The maximum, optimum and minimum concentration of Veratrine for affecting the chromosome structure ranges from 0.9%-0.0001%, data being derived from some dicotyledonous and monocotyledonous plants. But dicots in general are more susceptible to this chemical at a lower concentration and reveal more fragments than monocots. After suitable treatment recovery experiments were performed in Knop's solution for 1 hour and 2 hours recovery to study the fate of the cells affected.

Specific concentration zone for polyploidising effect in *Allium* is 1½ hour treatment in 0.6% solution in cold, followed by a recovery of 24 hours in Knop's solution.

For karyotype analysis in *Allium* 40 minutes treatment in 0.1-0.4% solution in cold has been found to be suitable.

To induce single chromatid break in case of *Allium* 1 hour treatment in 0.5% solution in cold is suggested. Series of experiments performed with both monocotyledonous and dicotyledonous plants in working out the properties of Veratrine therefore, reveal the three principal aspects of its behaviour, viz., polyploidising capacity, capacity for karyotype analysis and, finally, inducing chromatid break.

## 75. Application of New Technique to the Cytogenetical Investigation of Palms

S. K. SARKAR, Calcutta.

Cytogenetical study of Palms in India, following improved technique with Aesculine, devised for the purpose, is the object of present investigation. Present report deals with 30 species distributed in 20 genera.

Different evolutionary lines on the basis of somatic and meiotic behaviour have been traced within the family, Palmæ.

Evidence of different chromosome number in addition to the normal one, in the same tissue was brought forward and their significance in evolution has been pointed out.

The role of apomixis in the development of fruits in Palms has been emphasised.

## 76. Studies on the Structure and Behaviour of Chromosomes of a Few Species of the Genus *Lathyrus*, as a means of Detecting the Interrelationship between the Species.

P. C. DATTA, Calcutta.

A karyotype analysis of four different forms belonging to three species of the genus *Lathyrus* has been done. The species differ from each other in slight morphological details, the chromosome number being 14 in the diploid cells of all of them. Their origin from a common stock with 7 chromosomes in the basic set has been suggested.

Evidences of abnormal behaviours of chromosomes, viz., Inversion bridges, Nondisjunctions, Laggings etc. (excepting *L. aphaca*) have been gathered, showing the role of structural rearrangements of chromosomes in the evolution of all these species.

As the percentage counts of sterile pollens in species having high percentage of lagging chromosomes are in proportion much higher than those having P.M.C.s showing high percentage of nondisjunctions of bivalents, it has been suggested that probably the pollens with extra chromosomes remain viable and as such a thorough search in nature may reveal the occurrence of Trisomics, Tetrasomics, etc.

The theory of the constancy and specificity of the relative size difference between nucleoli, and numerical correspondence between the maximum number of satellites and the maximum number of nucleoli present in the nuclei of the species, has been corroborated from the present investigation.

**77. Pollen grain Smear Method for Cereals.**

P. N. BHADURI and B. R. MAJUMDAR, New Delhi.

Anthers containing actively dividing pollengrains were treated first with 0.2 per cent solution of colchicine, washed in water for an hour and then treated again in 0.002 M aqueous solution of 8-oxyquinoline at 10° to 14°C. for 1 hour. The anthers were washed in water for 1 hour and then fixed in Carnoy's solution (Alcohol, Chloroform and acetic acid in 6 : 3 : 1 proportion) for 6 hours to overnight. They were washed successively in acetic-alcohol (1 : 1) 10-15 minutes, 70 per cent alcohol 10-15 minutes and in water for ½ hour before hydrolysing them in bulk in N.HCl at 60°C for 10-15 minutes. The anthers were stained in leuco-basic fuchsin for ¼ to ½ hour. Pollengrains were squeezed out of a stained anther in a small drop of egg albumen on a slide and the albumen smeared uniformly on the slide. The slide was dipped successively for few seconds in glacial acetic acid and 45 per cent acetic acid respectively. The smear was covered by a cover glass in a drop of aceto-carmin and pressed gently between folded filter papers. The coverglass was sealed with paraffin and stored overnight.

To make the preparation permanent the paraffin was removed and the cover glass separated in a 1 : 1 mixture of acetic acid and n-butyl alcohol. The slide and the cover glass were then passed through n-butyl alcohol, 2 changes and finally covering in neutral balsam.

**PHYSIOLOGY****78. The effects of certain synthetic growth regulators on the vernalization of *Brassica campestris* L.**

S. C. CHAKRAVARTI and V. N. KRISHNA PILLAI, Bhopal.

Present investigation deals with the effect of IAA, IBA, NAA, 2,4-D, TIBA and coumarin in varying concentrations when applied as: (i) pre- and post-vernalization soaking of seeds, (ii) foliar sprays and (iii) an injection through the cut surfaces of the cotyledonary leaves. Similarly treated unvernallized seeds or plants act as controls. Time taken from the date of sowing up to anthesis (considered as vegetative cycle) by the individual plants of a treatment is recorded.

Data collected indicate that (i) pre-vernalization treatments with 2,4-D and TIBA lead to different degrees of inhibition of flowering induced by vernalization; while those with IAA, IBA and NAA result in a further shortening of the vegetative cycles over that found in plants raised from vernalized seeds without such a chemical treatment, (ii) pre-sowing soaking treatments of normal and vernalized seeds with all the chemicals named above excepting coumarin result in a delay in flowering and (iii) applications of auxins and TIBA as foliar sprays generally produce an earliness in flowering in both vernalized and normal plants.

From these observations it is concluded that (i) once the chilling treatment is over, the ultimate substance(s) formed is not affected by either an auxin or its antagonist as the nature of response of both vernalized and normal plants to the various modes of application of different growth regulators is similar, (ii) the general applicability of the theory of "auxin/anti-auxin" ratio put forth by certain workers to explain the mechanism of flowering is open to question as 2,4-D, an auxin and TIBA, an antiauxin have similar effects on the flowering of mustard and (iii) probably 'vernalinal' cannot be classified either as an auxin or its antagonist as pre-vernalization treatments with the different auxins do not produce similar effects.



**79. On the effect of moonlight on the growth of *Petunia hybrida* Linn.**

T. C. N. SINGH, Annamalaiagar.

Two sets of *Petunia* plants were grown in pots under identical physiologic conditions except for the fact that one set of plants received the full moon-shine throughout their life-history whereas the other was totally shielded from receiving it. Remarkable differences have been found in their general performance. These are tabulated as under:

S. No.	Plants shielded from Moonshine	Plants exposed to full Moonshine
1.	Growth in height taller ...	Growth in height stunted.
2.	Branching more profuse ...	Branching less so.
3.	Diameter of stem thinner ...	Diameter of stem thicker.
4.	Number of leaves greater ...	Number of leaves lesser.
5.	Leaves narrower and thinner ...	Leaves broader and thicker.
6.	Flowering earlier ...	Flowering delayed.
7.	Number of flowers much more and profuse but smaller in size	Number of flowers smaller and less profuse but bigger in size.
8.	Fruits very many ...	Fruits fewer.

This phenomenon has tentatively been termed as *Lunotropism*. In the present case, however, *Petunia hybrida* is negatively Lunotropic.

**80. On the response of structure of the leaves of *Balsam* and *Mimosa* to the Musical sounds of Violin.**

T. C. N. SINGH and (MISS) STELLA PONNIAH, Annamalaiagar.

*Impatiens balsamina* Linn. (Balsam) plants were excited daily for a period of nine weeks with *Maya-malava-gaula raga* played on violin exactly as in the case of *Mimosa pudica* (Singh & Ponniah, *Huitieme Congress International de Botanique (Paris), Rapports et Communications Aux Section 11*, 1954, pp. 195-196). The general performance of the experimental plants was significantly superior to that of the control. Marked differences were also noticed between the structural characteristics of both; namely, as compared to the control, in the experimental plants

- The number of stomata per unit area was 66% higher;
- The epidermal cell walls were thicker;
- In general the cells of mesophyll were bigger;
- The palisade cells were about 30% longer and 50% broader;
- There was an additional layer of palisade cells;
- Raphide crystals were profusely scattered particularly in the upper epidermal and the palisade cells;
- In a number of leaves examined the starch content was found to be higher.

*Mimosa pudica* Linn. (Sensitive plants) plants excited by the single note of violin for the usual duration of 25 minutes daily between 7 A.M.—8 A.M. throughout their life-cycle confirm the previous results from the view point of their general performance (Singh & Ponniah *loc. cit.*). Certain structural changes have also been observed in the experimental plants e.g.

- Stomata per unit area was found to be 55% higher.
- Palisade cells were found to be 25% longer.

## 81. On the effect of musical sounds of stringed instruments on the growth of plants.

(MISS) STELLA PONNIAH, Annamalainagar.

Four species of flowering plants were experimented upon. The results are presented as under :

*Mimosa pudica* Linn. (Sensitive plant) : On the advice of Professor Julian Huxley, plants of *Mimosa pudica* were excited by playing the single note *fa* on violin for a period of 25 minutes every morning between 7 A.M. and 8 A.M. Almost similar results were obtained in the present experiment as by exciting *Mimosa* plants by playing *Maya-malava-gaula* on violin (Singh & Ponniah: *Huitieme Congress International de Botanique* (Paris), *Rapports et Communications, Aux Section 11, 1954*, pp. 195-196). In the experimental plants :

- (a) The average total growth in length of branches was 30% greater.
- (b) The number of leaves and prickles were respectively 50% and 25% higher.
- (c) The roots were very highly fibrous with profusely developed root-nodules.

Similar development of root and root-nodules were also observed in *Mimosa* plants excited by *Karahara-priya raga* on *Vina*.

*Impatiens balsamina* Linn. (Balsam) : Plants of Balsam were excited exactly as in *Mimosa* by playing *Maya-malava-gaula raga* on violin (Singh & Ponniah, *loc. cit.*). The experimental plants on an average had grown taller to the extent of 15% and the average percentage increase in the number of leaves was 55% ; besides the leaves were found to be significantly thicker to touch than the control. The root-system of the experimental plants were profusely fibrous with prominent swellings on them.

Almost similar results have been obtained by exciting Balsam plants by *Karahara-priya raga* played on *vina*. As for example the average length of the shoot was 20% greater than the control; and the percentage of production of leaves was 72% over the control. Besides in general the leaf area of the experimental plants was also greater than the control.

*Tagetes erecta* Linn. (Marigold) : Marigold plants were also excited like *Mimosa pudica* by playing *Maya-malava-gaula* on violin (Singh & Ponniah, *loc. cit.*). As compared to the control plants, the experimental plants had grown over 40% taller, the increase in the number of leaves was 30% higher but the reproductive phase was delayed by about six weeks.

*Hydrilla verticillata* Presl. : *Hydrilla* plants raised from cuttings (clones) were excited by playing the single note on violin for a period of 25 minutes in the morning between 7 A.M. and 8 A.M. Significant increase both in the number of branches and the total length in the experimental plants have been observed respectively to the extent of 45% and 50% higher than the control.

Similar experiments are in progress with seedlings raised from clones of Sugarcane, tapioca, onion, garlic, ginger and sweet-potato.

## 82. On the Vernalizations of bulbs of Onion and Garlic.

S. PANNIRSELVAM, Annamalainagar.

Two varieties of Onion (viz. Bellary Onion and Local Onion) and one variety of local garlic were vernalized in Kelvinator for a continuous period respectively of 30 and 25 days at a uniform temperature of 7°C. After the expiry of the period they were all sown under field condition with proper controls. Under each treatment it was found that the plants matured earlier and the number, weight and volume of bulbs were significantly greater. Both the varieties of vernalized Onions flowered much earlier than the control : in fact the number of Onion plants entering the flowering phase was much higher in the experimental sets. In the case of Garlic neither the experimental flowered nor the control. Single plant seeds of



Onions of both experimental and control have been separately collected for further investigations.

### 83. On the Vernalization of the cuttings of Sweet-potato.

T. C. N. SINGH, Annamalainagar.

Suitable healthy cuttings of Sweet-potato (*Ipomoea batatas* Lamk.) were vernalized in Kelvinator at a temperature of 7°C. for periods extending from one to four weeks. Experiments with these vernalized cuttings were performed both in pot-culture as well as under field conditions. The vegetative performance of the plants raised from vernalized cuttings was found to be superior to that of the control and the yield of root-tubers was also found to be significantly superior namely about 40% higher than the control. Further work in the same line is being pursued.

### 84. The action of Beta Indolyl butyric acid on the rate of growth of *Pisum arvense*. L.

S. NAIK, Sambalpur.

With a view to investigate the effect of growth promoting substances on the rate of growth of *Pisum arvense*. L. experiments were performed with Beta Indolyl butyric Acid.

Fresh seeds were treated with the hormone in watery solution at various concentrations ranging from 1 ppm. to 10 ppm. The period of soaking of the seeds was 6, 12 and 18 hours respectively at 30°C. The hormone treated seeds were washed in tap water and then were sown separately in different plots in the garden. Then the growth in heights of different plants were measured after every week and the results were recorded. The mean rate of increase in height during the week was noted.

The results show that  $\beta$ -Indolyl butyric acid has got growth promoting effect on *Pisum arvense*. L. The rate of growth is effected by the concentration of the hormone solution. As doses were lessened the growth became more and more pronounced. So lower is the concentration higher is the rate of growth. It also shows that the growth hormone is effective even in very low dilutions and probably acts as a inhibitor only in high concentrations.

### 85. Effect of long and short photoperiods on incidence of flowering in wheat and gram.

S. N. BHARDWAJ, Agra.

The effect of two photoperiods of 16 hours (7-30 A.M. to 11-30 P.M.) and 8 hours (7-30 A.M. to 3-30 P.M.) on ear-emergence in two varieties of wheat, N.P. 165 and Cwn. 13, and on opening of first flower in two varieties of gram, N.P. 28 and N.P. 58, has been studied in pot cultures. The treatment was given for a period of two weeks, commencing from four weeks after sowing. Six replications were maintained including the controls.

In both the varieties of wheat, short photoperiod significantly retarded ear-emergence by about seven days, while long photoperiod accelerated it by one day, the latter being non-significant. The two varieties of gram did not behave uniformly. The short photoperiod apparently had no effect on N.P. 28 (early var.), while the flowering was significantly hastened by 10.5 days in N.P. 58 (late var.). The long photoperiod, on the other hand, delayed flowering by 5.8 and 10.0 days (significant) in the two varieties respectively.

The present results are in line with the findings of the previous workers as regards wheat; but the effect on gram is just the reverse of what has already been reported, and the causes are under investigation.

**86. Rooting response of the Twigs of *Aristolochia Gigas*, Lindl.**

B. SAMANTARAI and H. PATTNAIK, Cuttack.

Twigs of *Aristolochia Gigas*, Lindl. were treated with  $\beta$ -indolyl acetic acid, (I.A.A.),  $\beta$ -indolyl butyric acid (I.B.A.), and  $\alpha$ -Naphthyl acetic acid (N.A.A.). It was found that excepting I.B.A. the other synthetic hormones produced no effect on these twigs and I.B.A. again only produced small swellings. By treating these twigs with a complete Hoagland's solution no further effect was obtained but a treatment in a mixture of 100 p.p.m. (parts per million) of aqueous solution of aneurine hydrochloride and 100 p.p.m. of nicotinic acid (aqueous solution) twice in a week for one week only produced copious roots. It is suggested that auxin brings about conversion of permanent tissues to meristematic ones and organises them to root primordia whereas food and vitamin B serve as growth factors of the roots.

**87. Effect of feeding on the rooting response of isolated leaves of *Ipomoea batatas*.**

B. SAMANTARAI and T. KABI, Cuttack.

Rooting response of the tropical leaves of *Ipomoea batatas* has been studied in relation to synthetic hormones and it is found that 2.5 parts per million (ppm.) of I.B.A. ( $\beta$ -Indolyl butyric acid) serves as the best root inducing substance. Further, feeding these isolated leaves with sucrose and asparagine separately and together greatly enhances the rooting response both in the treated and control cuttings. This enhanced response is due to the extra supply of energy necessary for the organisation of root primordia and their growth into roots.

**88. Induction of roots with higher number of proto-xylem poles in Dicot seedlings.**

B. SAMANTARAI and S. K. SINHA, Cuttack.

*Cicer arietinum* and *Phaseolus radiatus* were taken to represent two types of seeds from the point of view of germination. The former has hypogeal germination whereas the latter has epigeal type. Removal of the apices of the primary roots at seedling stages brings about formation of greater number of lateral roots with higher number of proto-xylem poles in *Cicer*. But no such thing happens in *Phaseolus*. This is ascribed to availability of food stuff in greater quantity after decapitation of the roots in *Cicer* whereas in case of *Phaseolus*, the whole food stuff is utilised in the elongation of the hypocotyl, very little being available to bring about such change in the lateral roots.

**89. Effect of various levels of Nitrogen on the vegetative growth and ear emergence of rice plants.**

G. MISRA and B. SAMANTARAI, Cuttack.

An attempt is made to find out the role of different levels of Nitrogen on the vegetative growth and ear emergence of rice plants. Nitrogen was supplied as Ammonium nitrate and the plants were grown in sand culture. The nutrient solution used was that of Gregory and Richards as modified by Sircar and Sen. Full N, 1/3N, 1/9N, 1/27N and 1/81N were the levels applied. It is seen that early application of full Nitrogen though might not have any effect immediately,



has a far reaching effect in determining the nature of tiller growth when full application is made at later stage. Nitrogen at all levels increased height and full Nitrogen promoted and maintained the growth of green leaves. Full doses of Nitrogen are not only necessary at later phase of growth but are required at early stages for better utilisation of further quantities later. So far as date of ear emergence is concerned no significant difference is observed in any of the treated sets.

#### 90. Changes in titratable acidity in isolated leaves during the period of root emergence following hormone treatment.

B. SAMANTARAI and D. N. MOHANTY, Cuttack.

Isolated leaves of *Ipomoea digitata*, L. of three different ages were treated with aqueous solution of I.B.A. ( $\beta$ -indolyl butyric acid) at 2.5 p.p.m. (parts per million) and kept in water for emergence of roots. Analyses of these leaves were made before and every third day after treatment for titratable acids. It was found that in the young leaves the titratable acids rise suddenly to a very great quantity and then decline. In the leaves of other ages similar rise and fall are to be seen but they are not so marked as they are in the young leaves. This sudden rise and subsequent decline of titratable acids is bound up with the hydrolysis due to hormone administration, subsequent translocation to the petioles and final and quick consumption in the formation of roots.

#### 91. Induction of Drought Resistance in Rice plants.

B. SAMANTARAI and A. S. DUBEY, Cuttack.

Due to uncertainty in the weather condition in our country, the rice crops in certain areas succumb to periodic droughts. Drought resistance is very much linked with the elongation of roots as seen in xerophytic plants. As the xerophytic plants can withstand drought effectively, the leaf and root extracts of *Saccharum spontaneum*, a xerophytic plant were tried. 5, 10 and 15% of leaf and root extracts of *Saccharum* were injected to the sterilised rice grains under low pressure and after a week the seedlings were again injected with the above concentrations. The seedlings were then transplanted in pots containing 40 lbs. of soil and 5 lbs. of farmyard manure. These seedlings in the pots were watered for a week and then the pots were separated to various groups and watering was controlled, i.e., some were watered daily, and others at intervals of 1, 2 and 3 weeks. These results show that root extracts in all concentrations seem very much effective in producing root length and thereby inducing drought resistance. The leaf extracts have brought earliness in flowering. The effective root elongation and consequent drought resistance of rice plants is ascribed to the presence of a probable root growth substance in the root extracts of *Saccharum spontaneum*.

#### 92. Preliminary Studies on the Effect of Different Dates of Sowing in Mesta and Roselle.

A. N. DATTA, P. SANYAL and B. C. KUNDU, Barrackpore.

Date of sowing experiments in replicated randomized blocks sown at an interval of 14 days were conducted with both mesta (*Hibiscus cannabinus* L.) and roselle (*H. sabdariffa* L. var. *altissima*).

In *H. cannabinus*, sowing in the first week of April has given the maximum plant height, base diameter, green weight and fibre yield and in the later sowings beyond first week of April, gradual decrease in fibre yield, green weight, plant height and base diameter have been observed.

In *H. sabdariffa*, highest plant height, base diameter, green weight and fibre weight have been obtained in the sowing of the first week of March. The decrease in plant height, base diameter, green weight and fibre yield in the later sowings, however, started earlier, that is, first week of March unlike *H. cannabinus*.

Plant height and base diameter have strong positive correlation with fibre yield in both mesta and roselle. The correlation values of plant height and base diameter on fibre yield are +0.81 and +0.99 in *H. cannabinus* and +0.95 and +0.89 in *H. sabdariffa* respectively.

In *H. cannabinus* vegetative growth continued during the period of long-days and flowering started with the advent of short-days. In *H. sabdariffa*, however, flowering occurred in November when the days were still shorter and the temperature was lower.

The present work indicates that early sowing should be preferred in both mesta and roselle for higher yield of fibre.

### 93. Growth Sequence in Relation to Stalk and Foliage in Jute (*Corchorus*).

B. K. KAR and S. K. MAJUMDAR, Barrackpore.

The production of fibre in jute is dependent upon the vegetative growth of its stem in length and diameter. It has been shown previously that specific variations were found in the rate of growth of different components like crude bark, wood and fibre during the life cycle of the different varieties both from *Capsularis* and *Olitorius* species. Here the investigation has been further extended to study the relation of stalk and foliage growth during the different stages of plant growth. The following results were obtained:—

1. In D154 (*Capsularis*) the proportion of stem and leaf weights at 45 days growth was 71.5% and 24.5% in terms of total green weight. At 66 days growth the weights increased to 74.5% and 25.5%. In later stages due to leaf fall the weight of leaf was reduced to 17.4% to 16.4% while stem showed 82.7% to 83.6%.
2. In Chinsura green (*Olitorius*) the proportion of stem and leaf weights at 45 days growth was 71.9% and 28.1% but from 66 days onward the growth of stem in C.G. was more than the corresponding growth in D154 but the weight of the leaves in C.G. was found to be less than that of D154 showing more foliage production in D154.
3. The range of growth and development of individual leaf was found to be the same in both *Capsularis* and *Olitorius* but the leaves of *Capsularis* were more resistant to drought and unfavourable salt conc. in the soil as shown by a longer period of retention on the stem and comparatively less leaf-fall than in *Olitorius*.
4. The relation of foliage growth and branching habit to that of fibre output is being further investigated.

### 94. Increasing the fertiliser phosphate availability to plants and testing chemical methods for available phosphate determination.

H. N. MUKERJEE, S. C. MANDAL and B. S. BANERJEE, Sabour.

A view was held in the past, that Indian soils generally do not require phosphates, but over 15,000 experiments on the fields of cultivators in Bihar and a large number in other States have recently shown that phosphates may give additional yields, if used in conjunction with nitrogen, on most Indian soils. The demand for phosphates amongst cultivators is however low and in 1952-53, India consumed 78,000 tons of net nitrogen but only 8,000 tons of  $P_2O_5$ . As best crop



yields are generally obtained with equivalent amounts of N and P, a demand for P has to be built up. Pushing up crop yields with nitrogen alone is bound to lead to serious P deficiencies, in course of time.

As nitrogen of the same money value gives almost double the extra yield compared to P, the only way to popularise the use of P is to make use of cheaper sources and find out methods by which the fertiliser may go a longer way. It has been shown by the present work that cheaper phosphates like rockphosphate, of which there is a big deposit in Bihar, may be almost as effective as superphosphate even in Sabour soil of pH 7.4. This is expected to act even better in acid soils of the north and south.

Contrary to expectations, placement of superphosphate at depth did not prove better than surface application, on maize and wheat at Sabour, but 2 maunds of extra yield per acre, was obtained on gram. The experiment is being extended on other soil types, and soil conditions appear to be important in bringing out placement effects.

Remarkably good results have been obtained by applying phosphate at the time of turning of sann-hemp green-manure crop. During two years, superphosphate gave 3.3—5.5 maunds and rockphosphate gave 3.5—3.8 maunds extra yield of wheat, when thus applied. It appears that organo-mineral phosphates are formed, which help to keep the P in a more available form for a longer time.

Another method which succeeded in making both the superphosphate and rockphosphate P more available was acidifying the soil with sulphur or sulphuric acid. pH was lowered from 7.4 to 6.4, and the soils showed 52 p.p.m. P by Olson's method as compared to 48 p.p.m. in the untreated soil. The solubility of calcium or potassium were not much affected due to acid treatment. The plants from the acid-treated plots showed much higher P in tissue tests, and the effect of this extra available P was reflected in higher straw and stalk yields of wheat and maize, but not on the grain, under Sabour conditions.

A comparison of the methods of Truog, Olson, Bray and Arnold and Rice Williams for available P determination, showed that very variable results like 36 p.p.m. P by Olson's, 110 by Truog's and 566 by Bray's method, for the same soil may be obtained. In the 11 soils studied Olson's method correlated best with crop response, and may be used for advisory work in the area.

Both superphosphate and indigenous phosphate may thus be made to yield better, by a judicious adoption of the above methods.

## 95. Oil and Tannin from *Caesalpinia Digyna* (Teri).

B. P. GYANI, M. MURARI and A. C. ROY, Patna.

*Caesalpinia digyna* or Teri grows in abundance in North Bihar. It contains a pale yellow oil which amounts to over 9% of the seed. The oil is free from nitrogen and sulphur, has a low refractive index (1.471), acid value 5.3, soap value 184.8, iodine value 27.3 and negative hexabromide test. It appears to be edible. The seeds have about 31% tannin, 27% non-tannin and 43% insoluble in acetone. The pods (without seeds) have 51% tannin, 17% non-tannin and 3% insoluble matter.

## 96. Studies in Pollen Germination.

B. M. JORHI and I. K. VASIL, Delhi.

Pollen of *Pennisetum typhoideum* (T. 55, I.C. 1472), *Gossypium herbaceum* and *Arachis hypogea* (TMV. 2, 115) have been germinated by hanging drop technique. In the first named plant the pollen is 3-celled at the time of shedding

whereas in the other two plants it is 2-celled. Germination tests were carried out in distilled water, various concentrations of sucrose and in sugar-agar medium.

The pollen of *Pennisetum* usually bursts in 5, 8 and 10% sucrose solutions and only a few grains give out short protuberances. Maximum germination (48%) was obtained with the addition of 0.01% boric acid to 10% sucrose in agar medium. The tubes reached a maximum length of 1663 microns in 2 hours and 40 minutes after sowing. The two male cells and the vegetative nucleus were clearly seen in the tube.

In *Gossypium* the pollen grains burst in sucrose solutions up to 35%. In 40% sucrose-agar and 0.01% boric acid, 35% of the pollen grains germinate and the pollen tubes reach a maximum length of 450 microns in about 2 hours. As a rule only a single pollen tube emerges from each pollen grain but frequently there may be 2 to 5. Two elongated sperm cells and the vegetative nucleus were observed in the tube. Badami (1922), Banerji (1929), Shibuya (1932), and Iyengar (1938), who also tried germination of pollen of cotton *in vitro*, did not get satisfactory results.

In *Arachis* pollen grains did not germinate in 5, 8 and 10% sucrose solutions. In 10% sucrose-agar with 0.01% boric and maximum germination was 27%. After 1 hour and 55 minutes of sowing the tubes reached a maximum length of 4,680 microns. Callose plugs are formed in the tubes.

The present investigation shows that addition of traces of boric acid in the nutrient medium induces and accelerates pollen tube growth. Effect of vitamins, hormones and chemicals on pollen tube growth is also being studied.

#### 97. Studies on the Pollen Grains of Crop Plants—Maize (*Zea Mays*) II. Effect of Ovule and Silk Extracts, Calcium Nitrate and Phenoxo Compounds on the Elongation of Pollen Tubes.

B. SEN and GYANENDRA VERMA, Almora.

Pollen grains of 9 inbred, 5 single cross and 3 double cross strains of maize were first germinated in 12.5% sucrose containing 0.5%, 0.75% and 1% agar, to find out the most suitable media for their growth. No relation between the genetic make up of the strains and the optimum agar concentration in germinating media could be found.

Effect of incorporating the water extracts of unfertilised ovules and of silk of young cobs in the germinating medium on the elongation of pollen tubes of maize was observed. Suitable dilutions of ovules and silk extracts singly and in combination were found to stimulate pollen tube elongation. The observed pollen tube growth in case of S.C. 102 was: Control medium (12.5% sucrose+0.75% agar) 620 microns; Control medium+ovule extract—766 microns; Control medium+Silk extract—796 microns; Control medium+Ovule extract+Silk extract 944 microns.

Length of pollen tubes of maize W. 240 and Macer Yellow germinated in control medium containing the following growth promoting substances were respectively—Control 486 and 370 microns; 2,4-Dichlorophenoxyacetic acid (1 p.p.m.) 546 and 406 microns; 3,4,5-Triiodobenzoic acid (0.5 p.p.m.) 567 and 426 microns; O-Chlorophenoxypropionic acid (0.01 p.p.m.) 558 and 392 microns; Alpha-naphthaleneacetic acid (2.5 p.p.m.) 626 and 424 microns; Beta-naphthaleneacetic acid (0.25 p.p.m.) 470 and 470 microns; Phenylacetic acid (0.001 p.p.m.) 509 and 482 microns; Indole-Butyric acid (0.01 p.p.m.) 468 and 374 microns and Colchicine (2 p.p.m.) 540 and 478 microns.

Calcium nitrate in combination with phenoxo compounds was found to bring about increased elongation of pollen tubes. The observed growth elongation of maize pollen tube of In. 3 was:—Control (12.5% sucrose+0.75% agar) 582 microns;  $\text{Ca}(\text{NO}_3)_2$  20 p.p.m. 626 microns; Phenyl-Acetic Acid 0.001 p.p.m. 674 microns; PAA+ $\text{Ca}(\text{NO}_3)_2$  762 microns; Indole-butyric acid 0.01 p.p.m. 786 microns;



IBA+Ca(NO<sub>3</sub>)<sub>2</sub> 812 microns; Beta-naphthaleneacetic acid 0.3 p.p.m. 996 microns; BNAA+Ca(NO<sub>3</sub>)<sub>2</sub> 1012 microns.

Longest tube length of 1340 microns was observed in case of In. 3 grown in sugar-agar medium with 0.005 p.p.m. Indole-3-acetic acid.

This study was undertaken in connection with the I.C.A.R. scheme on Plant Physiology and Cytology.

**98. Studies on the Pollen Grains of Crop Plants—Mustard (*Brassica campestris* var. Yellow Sarson Prain.) and Garden Pea (*Pisum sativum* L.).**

B. SEN and GYANENDRA VERMA, Almora.

Pollen grains of Mustard T 102 could not be germinated in liquid medium (pure sucrose solution) or sugar-gelatin media. The best medium found for germination of mustard pollen was 20% sucrose solution containing 1% agar. Effect of incorporating micro-concentrations of calcium nitrate 10 p.p.m., Potassium nitrate 10 p.p.m., Boron (as boric acid) 10 p.p.m., Manganese (as sulphate) 0.15 p.p.m., 2,4-D, 1.5 p.p.m., TIBA 0.5 p.p.m., and Colchicine 1 p.p.m. in the germinating medium on the growth elongation of pollen tubes of mustard T 102 was studied. The observed pollen tube growth in these media was—Control 118 microns; calcium nitrate 152 microns; potassium nitrate 146 microns; manganese 162 microns; Boron 134 microns; 2,4-D 156 microns; TIBA 150 microns; Colchicine 178 microns. Boron did not bring about marked stimulation of pollen tube growth.

The most suitable medium found for the germination of Garden Pea pollen was 10% sucrose solution containing 1% agar. Germination and growth elongation of pollen grains of 8 varieties of Garden Pea (Delwiche commando, Dehra, V.L. III/8, Boruneville, First-to-Report, Miller, Kanpur 17, Early Badger and Schiling) in the above medium were observed. Pollen grains that germinated better also produced longer tubes. Neither of these characters—pollen germination or pollen tube elongation—were found to be related to the vegetative phase or the yield potential or a variety.

These investigations were undertaken in connection with the scheme of Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

**99. Effect of Presoaking and Chilling Seeds of Mustard T 102, and Wheat Pb. 228 in Different Inorganic Media.**

B. SEN and GYANENDRA VERMA, Almora.

Studies on effect of presoaking and chilling seeds in different chemical solutions of life cycle and growth of plants are in progress here since 1950. Effects of presoaking mustard T 102 and wheat Pb 228 seeds for 72 hours and of chilling them for 3 and 7 weeks respectively in glass distilled water, Ca(NO<sub>3</sub>)<sub>2</sub> M/60 and M/100 KNO<sub>3</sub>, M/60 and M/100, B (as H<sub>3</sub>BO<sub>3</sub>) 10 and 20 p.p.m. Mn (sulphate) 0.075 p.p.m. and 0.3 p.p.m., Fe (sulphate) 2 p.p.m., Cu (Sulphate) 2 p.p.m., Zn (sulphate) 2 p.p.m., Mo (as (NH<sub>4</sub>)<sub>2</sub>MoO<sub>4</sub>) 2 p.p.m. and maltose 1% are reported. Presoaked and vernalised seeds of mustard were sown in pots, those of wheat in field.

*Mustard:*

(i) Plants from seeds pre-soaked in different media flowered significantly earlier than those soaked in GDW, in case of KNO<sub>3</sub> M/60 7.5 days > B 10 p.p.m. 6.1 > Cu 5.5 > Mg 5.4 > B 20 p.p.m. 5.3 > Ca M/60 4.7 > Mn 0.075 p.p.m. 3.9 > Fe 3.8 > Zn 3.4 days.

(ii) Life cycle of plants from seeds chilled in different solutions was similar to those chilled in glass distilled water except in case of Fe (-2.5 days) and Ca M/100 (1.04).

(iii) Vernalisation response varied from 44.6 days in case of seeds chilled in Boron 20 p.p.m. to 48.6 in case of Ca M/100. Flowers appeared in vernalised plants at 3.6 to 4.7 leaf numbers less than the control.

*Wheat:*

(i) Presoaked seeds in different solutions produced plants which flowered up to 40 days earlier than controls. Presoaking seed in different media brought about increase in yield and tiller number of plants.

(ii) As compared to plants from seeds chilled in G.D.W. those chilled in different media flowered 1.8 to 6.3 days earlier. Plants chilled in Mg, Zn and Mo showed decreased tillering. Yield in all cases was similar.

(iii) Vernalisation response (in days) in different treatments was Cu 11.2, Maltose 11.1, B 20 p.p.m. and Ca M/100 9.7, Mn 0.075 p.p.m. 9.4, Ca M/60 8.6, Zn 8.4, Mo 7.9, Mg 7.4, KNO<sub>3</sub> M/100 7.1, Mn 0.3 p.p.m. 6.9, KNO<sub>3</sub> M/60 6.8, Fe 6.7, B 10 p.p.m. 5.0, G.D.W. 4.9 days. Except in case of Mo (-1.3) tillers per plant were similar. Yield was significantly less in case of Ca M/60, Zinc, Mg.

This study was carried out in connection with the scheme of research in Plant Physiology and Cytology financed by the Indian Council of Agricultural Research, New Delhi.

#### 100. Estimation of Amino-acids in the Vernalisable and Non-Vernalisable Strains of Wheat.

B. SEN and D. K. VERMA, Almora.

In an earlier paper (Sen and Verma, 1954), it has been shown that the response of wheat strain to vernalisation does not depend on its basic protein content. Amino-acids of vernalisable strain, Atlas-50 and non-vernalisable strains, Frondoso and Jaya seeds have been determined with the idea of discovering any difference of amino-acid contents in the two groups of wheat.

Circular paper chromatography according to the modified method of Mohan Rao, V. K. (1953) and ascending paper chromatography after the method of Williams and Kirby (1948) were used for the estimation and identification of free amino-acids.

Preparation of the extract was done by hydrolysing the defatted seeds according to Richard, Raymond and Gunter (A Laboratory Manual—Academic Press, New York, 1952).

The solvent used was butanol, acetic acid, and water in the proportion of 40 : 10 : 50 (Giri, 1941), and 0.4% solution of ninhydrin was used as colour reagent.

Nine different groups of spots of amino-acids have been identified.

Jaya, a very early wheat variety, had the lowest amino-acid content except in case of spot Nos. 6 and 8, while in general the highest content of amino-acids was found in Frondoso. It was also found that l-cysteine is absent in Jaya. The results obtained do not show any definite relationship between the amino-acid contents and the vernalisability of the strains, but it is significant to note that l-cysteine is also absent in the chromatograms of vernalised seedlings of mustard T. 102, as shown by Sen and Sah (1955) in a separate paper being submitted.

Therefore, it may tentatively be assumed that the presence of l-cysteine delays the transition from the vegetative to the reproductive stage.

Expenses of these investigations were met from the I.C.A.R. scheme in Plant Physiology and Cytology.

#### 101. Permeability of the Plasma Membrane of Leaf Cells of rust resistant and Susceptible Varieties of Wheat.

B. SEN and H. C. JOSHI, Almora, U.P.

By using a simple method described earlier (Sen, B.—Roy. Soc. Proc. Vol. B, 94, 1923) electric resistance of leaves of seedlings of wheat has been measured to



find out the correlation, if any, between the diminution of the electric resistance under similar induction shock and their resistance to rust.

Leaves of rust resistance and susceptible wheat seedlings at similar stage of growth were used. For each experiment one leaf each of resistant and susceptible strain was used. Each leaf had four electric contacts at distances of 3 cm. The middle two were used for measuring the electric resistance of 3 cm. of the leaf and the outer two for stimulating the leaf with induction shocks.

Results of a series of experiments show that (i) the electric resistance of the leaf of rust susceptible variety is greater than that of the resistant variety (ii) under similar intensity of electric shock, the percentage diminution of resistance in the leaf of susceptible variety is greater, and (iii) the percentage recovery from the effect of stimulus is greater and quicker in the resistant variety.

It has been shown (Sen, 1923) that the change in the electric resistance of a plant tissue can be correlated to the permeability of the plasma membrane of its cells to ions—diminution of resistance indicating increased permeability and *vice versa*. Therefore the conclusions seem to be justified that (i) in the leaves of rust resistant variety of wheat there is greater number of free ions, (ii) for similar intensity of stimulus the permeability increase induced in the susceptible variety is greater than in the resistant variety and (iii) in rust resistant variety not only is the percentage increase of permeability less but that the recovery from the stimulus is greater and quicker compared to that in the susceptible variety.

More detailed work is in progress.

This work has been undertaken in connection with the scheme of Plant Physiology and Cytology which is being financed by the Indian Council of Agricultural Research, New Delhi.

## 102. Estimation of Amino Acids in control and vernalised Seedlings of Mustard T. 102.

B. SEN and H. P. SAH, Almora.

Using modified method of William and Kirby (1948) ascending chromatography, free amino-acids in vernalised and control seedling of mustard T. 102 have been determined.

The extract of the material was prepared by the method described by Block et al (1952), Giri's (1951) solvent butanol-acetic acid-water (40 : 10 : 50) was used. Whatman filter paper No. 1 was used throughout the work. A solution of 0.4% Ninhydrin in 95% acetone was used as the colour reagent.

Identification of the amino acids were carried out after Giri and Rao (1952). So far 16 amino-acids have been identified either singly or in groups. To obtain a comparative idea of the concentration of the amino-acids the areas of the spots in Chromatogram have been measured.

In general, it may be stated that the content of amino-acids with higher R<sub>f</sub> values is greater in vernalised material and of amino-acid with lower R<sub>f</sub> values in unvernalsed material. In the chromatogram of the extracts of vernalised seedlings, the first spot observed in control is absent. The spot has been identified as l-Cystein. It is tentatively suggested that one of the effects of chilling the seeds of mustard T. 102 is to eliminate one of the amino-acids in the seedlings from chilled seeds and which may in part be responsible for shortening the vegetative phase.

These investigations were carried out in connection with the scheme of research in Plant Physiology and Cytology which is being financed by the Indian Council of Agricultural Research, New Delhi.

**03. Effect of long daylength on three medium-early varieties of Rice.**

GADADHAR MISRA, Cuttack.

The effects of 24-hour long-day photoperiod on the growth, development and flowering behaviour of three medium-early varieties of rice, T. 3 (Basamati of Dehra Dun), T. 12 (Hanshraj of Unnab district) and T. 21 (Chawal of Rampur state) grown in Uttar Pradesh have been studied in pot culture experiments. Long days were given for 3, 4, 5 and 6 weeks in seed bed to separate sets. There is a gradual delay in the time of ear emergence of the main shoots as the duration of short-day treatment is increased from four weeks to six weeks. With four weeks long days in the seed bed the average delay is 4.05, 5.90 and 2.05 days respectively in the three varieties T. 3, T. 12 and T. 21. With six weeks long days in the seed bed the average delay is 6.25, 10.85 and 6.05 days respectively for the same three varieties. On the average, the grain yield shows a significant increase over the controls in the 3, 4 and 5 weeks long-day treatment sets.

**104. Effect of Long-day Photoperiod on Four Early Winter Varieties of Rice.**

GADADHAR MISRA, Cuttack.

Four early varieties of rice, two varieties T. 1145 (Usha of Puri district) and T. 36 (a selection from No. 1 Cuttack) grown in Orissa and the other two T. 23 (Kala Sukhadas of Banda district) and T. 17 (Bansi of Allahabad district) grown in Uttar Pradesh were treated with 24-hour long-day photoperiod at the age of 7 days for three and six weeks in seed bed in separate experimental sets. After exposure to long-day photoperiods for these different periods the seedlings were transplanted and grown along with the controls under natural day-length till the rest of the period. So far as date of ear emergence is concerned it was seen that all the varieties did not behave uniformly. There was a pronounced delay in ear emergence in the variety T. 23 whereas in the other three varieties the delay was not statistically significant. A significant increase in grain yield was, however, obtained by long-day treatment for three weeks in all the varieties, mainly due to the increase in the number of ears per plant and number of grains per ear. The setting percentage and one thousand grain weight were slightly different and did not contribute to the yield difference to any appreciable degree. The treatment for the longer duration of six weeks did not show any difference in grain yield from the controls.

**105. Effect of Long Photoperiod on Four Late-winter Varieties of Rice.**

GADADHAR MISRA, Cuttack.

The influence of 24 hour long-day photoperiod has been studied on four late-winter varieties of rice, C. No. 3 (a selection from Kajal Champa of Cuttack district), S.R. 26B (a selection from Kalambank of Puri district), F.R. 13A and F.R. 43B (both flood resistant varieties) of Orissa. The time to ear emergence was not affected by long days given to one week old seedlings for either 3 or 6 weeks in the seed bed. The long-day treatment for 3 weeks slightly increased the height of the plants and brought about a significant increase in yield in all the four varieties. This increased yield is mainly due to the pronounced increase in the number of grains per panicle, total number of spikelets per panicle, and percentage of grain setting per panicle over those of the controls.



**106. Effect of spraying  $\beta$ -indolyl acetic acid solution on the growth and reproduction of rice plants.**

G. MISRA and B. SAMANTARAI, Cuttack.

In order to determine the effect of synthetic hormones on the flowering of rice plants  $\beta$ -indolyl acetic acid (I.A.A.) of the strengths of 50, 20, 10, 5 and 2 p.p.m. (parts per million) was sprayed daily on to the foliage of 2 month rice plants in two pure strains, B. 76 (a selection from variety Putia-Shankar) and T. 56 (a selection from variety Boulchi of Puri district) till the time of ear emergence. There is an indication that the lowest concentration viz., 2.5 p.p.m. of I.A.A. shows slight earliness in the ear emergence, increase in number of tillers, number of leaves and height of the plants. The difference within the range of 50 p.p.m. and 2.5 p.p.m. do not seem significant in most cases, but from this tendency it seems that concentrations lower than 2.5 p.p.m. may be effective.

**107. Factors which influence the rooting response of isolated leaves of *Ipomoea batatas*, Lamk.**

B. SAMANTARAI and S. K. SINHA, Cuttack.

Isolated leaves of *Ipomoea batatas*, Lamk. were treated with  $\beta$ -indolyl Butyric acid (I.B.A.) for induction of roots. It was found that factors like the previous habitat of the leaves, the time of severance for treatment and the period of aeration of the water in which the leaves were kept after treatment had profound influence on the rooting response. Sun leaves produced roots much earlier than the shade leaves. Leaves severed towards the evening had better rooting than those severed in the morning or midday. These effects are probably due to the metabolic status of the leaves which might contain higher quantities of carbohydrates and protein in sun or towards the evening. Further, aeration of water caused better response possibly due to supply of necessary oxygen for the growth of roots, which in the absence of oxygen would grow anaerobically and hence lead to poorer growth.

**108. Cambial activation and secondary growth in the petioles of the rooted leaves of *Tridax procumbens*, L.**

B. SAMANTARAI and T. KABI, Cuttack.

Isolated leaves of *Tridax procumbens*, L. were rooted by the application of 10 parts per million of aqueous solutions of  $\beta$ -indolyl butyric acid and planted in soil. The petioles were examined at different periods and it was seen that intrafascicular cambium developed producing secondary tissues including parenchyma. No interfascicular cambium was developed, but there has been a tendency in the intrafascicular cambium to grow out laterally, of course, the adjacent ones, not uniting. The formation of cambium is ascribed to the synthetic hormone. Secondary growth in the petioles of *Tridax* leaves, supports the partial shoot theory of the leaf as elaborated by Arber.

**109. Photoperiodism in Relation to Factorial Lights.**

S. PANNIRSELVAM, Annamalainagar.

Six species of plants, namely, *Cosmos bipinnate*, *Helianthus annuus*, *Tagetes erecta*, *Impatiens balsamina*, *Celosia cristata* and *Petunia hybrida* were exposed to

new photoperiodic treatment hitherto not experimented before, designated as Factorial Lights of Morning Light (M) (6 A.M.—12 noon), Evening Lights (E) (12 noon—6 P.M.) and Artificial Light (A) (Emitted out of an incandescent filament of an electric bulb of 40 Watt.). All the aforeto-mentioned species of plants were subjected to the following 8 factorial light treatments; the total length of hour-length in each case was restricted to that of the control namely 12-hours which represents 6-hours of morning light plus 6-hours of evening light: 2A+6M+4E, 2A+4M+6E, 4A+6M+2E, 4A+2M+6E, 8A+4M+0E, 8A+0M+4E, 0A+2M+0E, 10A+0M+2E. A ninth set of experiment was also arranged under the treatment 12A+0M+0E. It has been shown that the dose of Morning Light is the most important determining factor in the general performance of each of the species of plants, whether vegetative or reproductive. A full discussion is given in the fuller paper.

The reading of the paper at the Botany Section will be illustrated by Magic lantern slides.

#### 110. Experiments on Induced Parthenocarpy in some plants.

R. C. SACHAR and R. N. CHOPRA, Delhi.

Experiments on the stimulation of the ovary and ovule have been started in this laboratory under an I.C.A.R. Research Scheme. Experiments were performed on six members of Cucurbitaceae (*Luffa acutangula*, *Lagenaria vulgaris*, *Cucumis sativus*, *Coccinia indica*, *Momordica charantia* and *Trichosanthes anguina*); two of Solanaceae (*Datura fastuosa*, and *Nicotiana rustica*); two of Papaveraceae (*Papaver rhoeas* and *P. somniferum*) and one of Caricaceae (*Carica papaya*).

IBA and NAA were tried. In cucurbits only lanolin pastes have been used, their ovaries being unsuitable for injections; while in other cases both pastes and injections have been tried. The hormone concentration ranged from 0.05-2.0% in pastes and in injections from 0.1-0.3%. Almost in all cases the best concentrations for the production of parthenocarpic fruits were 0.5% in paste and 0.1% in aqueous injections. In *Luffa*, *Papaver*, *Carica* and *Datura* many of the parthenocarpic fruits produced were as large as the natural ones, while in *Lagenaria*, and *Nicotiana* they were slightly smaller. In *Coccinia*, *Cucumis*, *Momordica* and *Trichosanthes* the size of the parthenocarpic fruits was much smaller as compared to natural ones. In *Cucumis* the shape of the parthenocarpic fruits differed from that of the natural ones, the former being narrower in the middle region. The internal structure showed absence of the central cavity, a much thicker fruit wall and greatly developed vascular tissue.

Along with fruit growth seed development was also observed in *Luffa*, *Lagenaria*, *Carica*, *Papaver*, *Nicotiana* and *Datura*; but in all these cases the growth of the seed coat was not accompanied by embryo or endosperm development. In *Datura fastuosa*, however, there was observed a proliferated mass of tissue in the ovules, similar to the one obtained by van Overbeek et al. (1942) in *Datura stramonium* and designated by them as "pseudo-embryo".

Of all the plants under investigation only *Papaver* and *Momordica* showed some tendency towards natural parthenocarpy, the controls of all the rest either got abscised or shrivelled away.

### PALAEOBOTANY

#### 111. Spores from Cambrian and pre-Cambrian beds of India and U.S.A.

A. K. GHOSH and B. BOSE, Calcutta.

Micropalaeobotanical examination of three pre-Cambrian rocks from the Cuddapah system, Kolhan and Gangpur series received from the G.S.I. and nine



north American Cambrian specimens obtained through the courtesy of Prof. B. Howell, Princeton University has resulted in the recovery of spores besides other microfossils. The spores are of the following types:—*Azonaletes* Lub., *Euryzonaletes*, *Trilobozonaletes*, *Monoletes* Ibr. and *Trilobosporites* Pant. On comparison *Trilobosporites* Pant appears to bear a semblance with *Leiotriletes* (Naum, 1910) emend. The occurrence of these spores specially the *Trilobosporites* (= *Leiotriletes*) type in such early beds tends to suggest a proterozoic origin of vascular plants with possibility of their polyphyletic order of development.

## SECTION OF ZOOLOGY AND ENTOMOLOGY

President :—DR. PURNENDU SEN M.Sc., Ph.D. (Lond.), D.I.C.

### Abstracts

#### CELL-BIOLOGY

##### 1. Analysis of Chromosomes in two genera of Microhylidae (Amphibia : Anura).

A. R. KASTURI BAI, Bangalore.

The only two genera of Microhylidae (Engystomatidae) whose chromosome numbers are known are *Cacopoides tornicri* ( $2n=28$ ) Sato 1936 and *Uperodon systoma* ( $2n=26$ ) Gowda 1948. Two more genera available in Bangalore were studied i.e., *Ramanella variegata* (Stoliczka) and *Microphyla rubra* (Jerdon). In both species the diploid number is 26 but an analysis of the chromosomes shows slight variations in their form. There are in *Ramanella* 16 metacentrics and 10 acrocentrics, while in *Microphyla* there are 14 metacentrics and 12 acrocentrics. The chromosome lengths of the two species in mitotic metaphase have been measured and they total  $8.6\mu$  in *Ramanella* and  $11.4\mu$  in *Microphyla*. Probably a variety of chromosomal rearrangements has taken place during the evolution of these two genera. They are discussed.

##### 2. Origin of Micronuclei in *Spirostomum ambiguum* E.

B. R. SESHACHAR and (Miss) P. B. PADMAVATI, Bangalore.

*Spirostomum ambiguum* is a large ciliate belonging to the order Spirotricha. The macronucleus is large, single, beaded and extends over the greater part of the body length. The micronuclei are variable in number from ten to a hundred. During the vegetative life of the animal, micronuclei are continually budded off from the macronucleus and this is the source of the increase in micronuclear numbers. Such a phenomenon has never been reported before and its significance is discussed.

##### 3. Histological and Histochemical Studies on the Coxal glands of *Palamnaeus gravimanus* Thorell.

T. SUBRAMANIA PILLAI, M. D. PARTHASARATHY and  
V. K. SUNDARARAJA IYENGAR, Bangalore.

A renewed investigation of the coxal gland of *Palamnaeus gravimanus*, collected from the vicinity of Bangalore, was undertaken by us with a view to have proper understanding of its function. Both histological and histochemical methods were applied for the purpose. Haematoxylin and Eosin sections of the gland were used for histological study. Alkaline phosphatase was detected by Gomori's technique and carbohydrates by the periodic acid-Schiff reaction. Control sections were treated with saliva to distinguish glycogen from other polysaccharides.

The homology of the coxal gland with the nephron of the vertebrate kidney is not absolute, for there is no vessel or sinus comparable to the efferent vessel



of the glomerulus and the latter itself, in scorpion is only in the form of vascular sinuses without endothelial walls receiving the coxal artery. The fate of the blood corpuscles entering the sinuses is not definitely known, though it may be presumed that blood plasma may filter through the saccule which corresponds to the Bowman capsule of the nephron. The epithelium of the labyrinth shows columnary cuboidal and squamous cells, all of which having striated bases away from luminal side. One noteworthy feature, not reported previously, is that villi-like processes extend outwards each possessing a conspicuous nucleus. The villi may extend either into the surrounding haemocoelic space or into the corresponding crypts of the saccule. Despite phyletic distinctions, the distribution of alkaline phosphatase shows that there is an interesting functional resemblance between the coxal glands of scorpion nephridia of worms and vertebrate nephrons. The presence of enormous quantities of glycogen throughout the tubule, as demonstrated by the periodic-Schiff reaction, indicates probably that the coxal gland acts not only as an excretory organ but also as an organ for glycogen storage. This view may not be far wrong when we realise that scorpions have great capacity to withstand starvation during six months or even one year.

#### 4. Observations on the Oocytes of *Boophilus microplis*.

B. DASGUPTA, Calcutta.

The ovary of the ticks *Boophilus microplis* was studied, specially with a view to make a qualitative study of the nucleic acid contents of the oocytes.

RNA was found to be unevenly distributed in cytoplasm of the oocytes. Some areas in the cytoplasm took up intense pyronine stain, while the remaining part was lightly stained. The nucleus contained one or several nucleoli. The peripheral zone of the nucleolus was rich in RNA, while the central area was not so. The nuclear membrane showed some affinity for pyronine. There was no trace of DNA in the nucleus. The above observation was also confirmed by Feulgen's technique.

Nucleolus of more ripe eggs was found to be vacuolated. Except for the vacuoles abundant RNA was found to be evenly distributed in the matrix of the nucleolus.

#### 5. Observations on the accessory glands of the male bed-bug.

B. DASGUPTA, Calcutta.

The accessory glands of the male bed-bugs (*Cimex lectularius columbarius*) consist of two parts; the gland proper consisting of branched tubules, and the reservoir, which is a saccular structure with thin and membranous wall. A short duct joins the two parts.

The accessory glands were subjected to investigation for a qualitative study of their nucleic acid contents.

The cells of the gland proper are voluminous structures and are very rich in RNA as evidenced by their great affinity for pyronine. The nucleus of the cells sometimes appears to lack a definite nucleolus. The matrix of the nucleoplasm is pyronine-positive. Abundant methyl-green stained particles lie scattered in the nucleoplasm.

The cellular lining of the reservoir is composed of thin cells. Here too the nucleus appears to lack a definite nucleolus. The cytoplasm and the nucleus are not so rich in RNA and DNA respectively, when compared with the cells of the gland proper. The above observations were confirmed by Feulgen's technique.

#### 6. A note on the wall of the testis of bed-bug.

B. DASGUPTA and H. N. RAY, Calcutta.

The testis of bed-bugs (*Cimex lectularius columbarius*) consists of seven lobes on each side. The lobes lie enclosed in a very thin wall formed of an inner epithelial sheath and an outer peritoneal sheath.

The importance of this fine wall of the testis is easily appreciated if the corresponding organ of the females is taken into consideration. For example, it has been suggested (Snodgrass, 1935) that the wall of the ovary absorbs nutrient materials from the blood, elaborates it in their cytoplasm, and passes it on to the developing egg in a direct or in an indirect way. Droplets of food-matters has, however, not been noticed in the ovarian wall. It is evident that similar consideration should apply to the testis as well, where nutritious substances are no doubt required for the growth of the sperms.

The testis of bed-bugs subjected to periodic acid-Schiff's reaction (PAS) have shown that their fine outer wall harbours a large number of polysaccharide granules in the cytoplasm. A new function is thus ascribed to the testis-wall, i.e., the storage of polysaccharides.

#### 7. Alkaline phosphatase activity in the female reproductive tract of bed-bug.

B. DASGUPTA and H. N. RAY, Calcutta.

Alkaline phosphatase has been histochemically demonstrated in the reproductive system of the female bed-bug (*Cimex lectularius columbarius*). In the nurse-cells the enzyme was found at the periphery of the cytoplasm, round about the nuclear membrane and on the border of the nucleolus. Similar reaction was obtained in the cells of the follicular wall.

The reaction was stronger in the lower part of the reproductive tract, i.e., in the ripe follicular chambers and in the oviduct. Only a thick black line sometimes represented the oviduct whose cellular structure was completely obliterated due to heavy deposition of cobalt sulphide.

#### 8. Evidence of Alkaline and Acid phosphatase enzymes in *Trypanosoma evansi*.

H. N. RAY, H. G. SEN and B. N. DUTTA, Calcutta.

Phosphatases, enzymes hydrolyzing esters of phosphoric acid are widely distributed and are known to play an important role in various metabolic processes such as carbohydrate metabolism, bone formation etc. Chen (1948) and Harvey (1949) have demonstrated adenosine triphosphatase in *Trypanosoma equiperdum* and *Trypanosoma hippicum* respectively, but the enzyme acid phosphatase which also plays an essential role in the metabolism of the parasites has not been demonstrated so far in such haemoflagellates.

With a view to studying the metabolism of the *Trypanosoma evansi* blood smears of rats showing a large number of parasites were fixed in chilled 80% alcohol and acetone respectively and Gomori's modified technique employed to demonstrate the sites of phosphatases in this organism.

*Alkaline phosphatase.*—Intense reaction for this enzyme was found to be localised in (1) nuclear membrane, (2) karyosome, (3) kinetoplast and (4) the entire length of the bordering flagellum. The reaction in the cytoplasm was of a very weak nature.

*Acid phosphatase.*—Very few granular deposition of lead sulphide in the cytoplasm indicated the localization of this enzyme in *T. evansi*.



### 9. Occurrence of Mucopolysaccharides in *Trypanosoma evansi*.

H. N. RAY, H. G. SEN and B. N. DUTTA, Calcutta.

Runnstrom (1945) advanced the view that a heparin like sulphate containing mucopolysaccharide, under certain conditions is able to inhibit enzymes which are responsible for protoplasmic clotting. It may be recalled that bacterial mucolipids are powerful agents able to stimulate, injure and destroy host cells and of the cell protoplasm this complex is an obligatory constituent (Monne, 1943). It is very likely that mucoids and mucolipids are able to prevent clotting by virtue of their hydrotropic properties.

During the course of our studies on the cytochemical pattern of *T. evansi* we have for the first time demonstrated the occurrence of mucopolysaccharides in the cytoplasm of this organism. Blood smears were fixed in Serra's fluid for 15 to 20 minutes and stained with 2% aqueous solution of toluidine blue (Brachet, 1953). The mucopolysaccharides appeared as violet granules in the cytoplasm of the flagellates and they were found to be aggregated towards the anterior end of the organism.

*Hyaluronic Acid type of Polysaccharide.*—It is a polyuronic acid composed of equimolar parts of acetyl-glucosamine and glucuronic acid. For the demonstration of mucopolysaccharides of the hyaluronic acid type the technique devised by Hale (1946) was followed.

Blood smears were fixed in Carnoy's fluid for 20 minutes and stained by Hale's method. Dot like granules stained bluish green appeared within the cytoplasm specially at the anterior end of the organism. From these observations it may be deduced that besides volutin granules, this flagellate also contains other reserve substances namely, the mucopolysaccharides and hyaluronic acid type of polysaccharides in the cytoplasm.

### 10. The Cytology of *Balantidium coli*.

P. C. SEN GUPTA and H. N. RAY, Calcutta.

A morphologically identical species of *Balantidium coli* is found to occur as a parasite of man, the rhesus monkey and the pig. Cytological studies undertaken with *B. colid* from the rhesus monkey have yielded the following results :

Mitochondria and Golgi complex were found to occur in the endoplasm of the ciliate.

The macronucleus was found to be made up of large chunks of DNA and the areas in it free from DNA were made up of RNA. The micronucleus also showed the presence of DNA. The basal granules of the ciliate showed up as minute grains of DNA. The endoplasm of the trophic form showed the presence of RNA but the reaction for RNA was very much stronger in the cytoplasm of the cysts.

The endoplasm of the trophic form showed positive reaction for polysaccharides, mainly glycogen, which occur as discrete granules. The endoplasm also stained diffusely for lipids. The reactions for polysaccharides, glycogen and lipids were more intense in the cysts than in the trophic forms. It was found that the protoplasm of the ciliate contained tyrosine-containing proteins.

Both alkaline and acid phosphatases were present in the macro- and the micronucleus, the basal granules of the cilia, the cilia and the walls of the cytophyge and the endoplasm showed a weaker and diffuse reaction. The intensity of reaction for these enzymes varied in the different structures and the cultural forms showed definitely less intense reaction than the ciliates in faecal smears.

### 1. Ionising Interference on the Levels of Organiser Action.

ASOKE BOSE and SIVATOSH MOOKERJEE, Calcutta.

The remarkable properties of the ionised cells of chick embryos have been previously shown by us (Mookerjee and Bose, 1953) in their total regulation upto a dosage of 600r. The first morphogenetic effects are produced by 700r and they are expressed in the defective forms of eye cup—lens induction. In these embryos, after an initial exposure to X-rays, the cells interact normally to produce typical results of the primary inductions but when these cells produce eye cup—lens at a later stage the secondary inductions are inhibited.

The real explanation of the radio-sensitive nature of the secondary induction may be sought in the time factor of a latent period of cells before they can stabilize a morphogenetic change.

### 12. Compositional changes during Phase variation of Amoebae.

BANSIDHAR HAJRA and SIVATOSH MOOKERJEE, Calcutta.

All the controlling factors which cause cystic and trophic conditions in an amoeba are still open problems. A straight cytochemical analysis has been made to locate the compositional difference in the ground substances of a soil amoeba—*Naegleria gruberi* under two alternate phases of cyst and trophic. The localization of alkaline phosphatase illustrates the following points:—

- (1) In the normal trophic forms, alkaline phosphatase is localized strongly in the nucleus, cytoplasm, and in nuclear membrane. It is absent only where a pseudopodial bulge occurs.
- (2) Recently formed cysts are strongly positive in the alkaline phosphatase like a trophic form.
- (3) In older cysts, kept isolated over two weeks, this enzyme reaction shows a less localisation. The localisation picture becomes greatly reduced in still older cysts. In cysts of three months old, the reaction becomes clear in the cytoplasm as well as in the nucleus. The cyst wall continues to be positive.
- (4) The trophic forms which emerged from the lowly positive alkaline phosphatase of three to four months old cyst, immediately becomes positive again for this reaction.

It is advanced that this compositional change of alkaline phosphatase during the cystic and trophic forms of amoebae might be an associate factor with the synthesis of proteins.

### 13. Cytochemistry of Evocator Complex.

SIVATOSH MOOKERJEE, Calcutta.

The exact nature of evocator complex is still an open question in experimental embryology. In order to strengthen our ideas about the nature of evocator, comparable cytochemical studies have been made on the secondary inductions in chick embryo. The sites of the study have been selected on the point of time when the optic cup rudiment interacts upon the lens placode of the ectoderm.

Zenker—fixed cells of both the competent ectoderm and the inducing cells are uniformly positive in their toluidine reaction for basophilia. A difference in the reaction to the interacting cells becomes clear by the Feulgen method. The layer of cells of the optic cups, touching the basal cells of the lens placode, is almost free from the Feulgen staining material. Other adjoining cells, both in the lens placode as well as in the optic cup give a positive Feulgen reaction. The Feulgen



negative but toluidine blue basophilia positive cells of the eye cup seem to be R.N.A. positive and D.N.A. negative material.

The alkaline phosphatase reaction is regular in the cells of the lens placode and optic cup.

The heterogenous nature of the cytochemical picture of the secondary induction tends to point towards a complex form of an evocator action rather than the nature of a single entity.

#### 14. Spermatogenesis of the Toad (*Bufo stomaticus*—"Lutkin") with particular reference to the Cytoplasmic inclusions.

G. P. SHARMA and K. S. DHINDSA, Hoshiarpur.

The present investigation comprises the study of the Cytoplasmic inclusions during the spermatogenesis of the toad, *Bufo stomaticus*—"Lutkin". The primary spermatogonium is by far the biggest cell in the testis and exhibits a phenomenon of nuclear polymorphism, forming several nuclear lobes by simple constriction.

The mitochondria first appear as small, lightly stained, dustlike particles in the primary spermatogonium, but become more prominent during the spermatogonial telephase and in the secondary spermatogonium. They grow in size and lie in a juxta-nuclear mass in the primary spermatocyte. The mitochondrial granules are evenly distributed, throughout the cell, during the meiosis I, and in the secondary spermatocyte. They also appear as such during the meiosis II, but cluster round the base of the axial filament in the spermatid stage, where a small middle-piece is formed by them. The mitochondria which are not so used up are finally sloughed off.

The Golgi bodies make their first appearance in the primary spermatogonium as one or more darkly stained big granules, which also appear during the spermatogonial divisions and in the secondary spermatogonium. One of them often shows a duplex structure in the primary as well as the secondary spermatocyte. In the spermatid, these Golgi granules show a distinct tendency towards close grouping and forming a few big granules. One of these becomes the acrosomal granule and is transformed directly into an acrosome.

The ripe sperm has an elongated nucleus, with a pointed acrosome at its tip and a small middle-piece behind the nucleus, near the base of which arise two axial filaments, united at the ends. The two axial filaments are closely packed during the early stages of spermateleosis and their separate identity cannot be made out. The mitochondrial cluster makes it impossible to trace the exact origin of these axial filaments and so the two centrosomes seen near the base of the axial filaments of the ripe sperm are not distinguished in the early stages of spermateleosis.

The axial filaments show a lashing movement, which is governed by the centrosomes, as seen under the Phase Contrast Microscope.

#### 15. A Study of the Cytoplasmic Inclusions during the Spermatogenesis of the Domestic fowl, *Gallus domesticus*.

G. P. SHARMA and K. K. NAYAR, Hoshiarpur.

The present investigation was undertaken with a view to study the form and behaviour and the ultimate fate of the cytoplasmic inclusions during the spermatogenesis of the domestic fowl, *Gallus domesticus*.

Both the Golgi bodies and the mitochondria are essentially granular in form with a tendency to clump together particularly in the spermatogonium, the spermatid and the resting stages of the spermatocytes, scattering through the cytoplasm during the maturation divisions with subsequent sorting out to the two daughter cells.

During the process of spermateleosis, an acrosomal vesicle makes its appearance in the region of the localised Golgi mass of the spermatid. The wall of this vesicle seems to be directly formed by the Golgi granules. In this vesicle is now differentiated the acrosomal granule which finally gives rise to the conical acrosome. The mitochondria, with the progressive attenuation of the nucleus, move to the posterior end where they form the mitochondrial sheath of a very short middle-piece.

In the late stages of spermateleosis, the nucleus has been observed in a coiled state in the cell, which is due to the continuous elongation of the nucleus and lack of any corresponding response from the cytoplasm.

The so-called accessory body which is, in fact, a part of the Golgi material, is present in the cytoplasm of the primary spermatocyte and certain later stages.

The ripe sperm is composed of an elongate worm-like head with a conical acrosome at its anterior tip, a very short middle-piece and a thin tail trailing behind. The mitochondrial sheath of the middle-piece appears, frequently, as a spiral structure, due to the irregular distribution of the mitochondrial granules.

#### 16. Structure and behaviour of the chromosomes in the wild population of *Halys dentatus* (Hemiptera-Heteroptera).

G. P. SHARMA and RAM PARSHAD, Hoshiarpur.

The present investigation has been carried out to analyse the variability in the wild population of *Halys dentatus* which is divided into two types differing in certain morphological characters like the size and colour and the food habits—one type feeding on the mango trees and the other on *Acacia*.

The diploid number of 14—chromosomes (12 A+XY) behaves normally as in the other Pentatomids with sex-chromosomes dividing equationally in the first meiotic division and reductionally in the second while the reverse is true of the autosomes. A marked difference in the nucleolus is observed in all the resting stages, being oxyphilic in one type and basophilic in the other. From the normal chromosome behaviour with anaphasic movements at right angles to the equator, parallel to the long axis of the spindle and complete chiasma terminalization by Metaphase I suggest these to be Acrocentric.

Chiasma frequency per nucleus varies from six to eight at diplotene and diakinesis, and from six to seven at Metaphase I.

Metrical analysis of the chromosomes at different spermatogonial metaphases reveals during the successive generations a continuous decrease in the total length of the monoploid genome which is also accompanied by the decrease in the area of the cell, though no correlation can be drawn between the two.

A comparison of the chromosomes length at Metaphase I reveals that the two types differ with respect to the length of the chromosomes no. 1. This difference, though statistically significant inasmuch as the two types are not drawn from the same population, is not of inter-specific nature as concluded from the 'Analysis of Variance'. The difference in the two types is of the nature of a single deletion or reduplication.

#### 17. Spermatogenesis of *Lygeus militaris*.

G. P. SHARMA and G. C. SUD, Hoshiarpur.

The present study was undertaken to investigate the structure, behaviour and the ultimate fate of the cytoplasmic components

In the resting spermatogonium a granular juxta-nuclear mass is seen fitting over the nucleus like a cap. The granules in this mass are probably the mito-



chondria. Later on, in this mass, are differentiated bigger and smaller granules the Golgi bodies and the mitochondria respectively.

In the primary spermatocyte the darkly-stained wigger Golgi granules and small, greyish mitochondrial granules are seen evenly scattered in the cytoplasm. During the prophase stages, mitochondrial threads are observed, which are probably formed by the linear alignment of the granules. During the anaphase of the meiotic divisions the Golgi bodies and some of the mitochondrial threads pass on as such to the daughter cells while the rest of the mitochondrial threads divide at the equator and then travel to the poles.

In the spermatid the mitochondria form the typical nebenkern of many insects. An axial filament, having its origin from double centrioles, divides the nebenkern into two halves, which now spin round the filament and form a sheath for the tail. The Golgi bodies fuse to form a vesicular acroblast which secretes a fine granule, the acrosomal granule, within it. This granule ultimately forms the acrosome of the mature sperm. The acroblast (Golgi-remnant) is sloughed off along with the residual cytoplasm.

#### 18. Spermatogenesis in *Eurybrachis* (Fulgoridae-Homoptera).

S. R. V. RAO, Pilani.

Two species of the genus *Eurybrachis* are studied, viz., *E. tomentosa* and *E. apicalis*. The diploid number is 26 in both the species. In the metaphase of the first meiotic division there are 13 bivalents i.e., 12 autosome bivalents and the sex bivalent (XY). These undergo segregation in the first division with the result that the secondary spermatocytes possess 13 chromosomes (12 autosomes and X or Y). However, in *E. apicalis* in a small percentage of spermatocytes, an abnormality is noticed in the segregation of partner chromosome in one of the autosome bivalents during the first meiotic division. The bivalent migrates to the pole. As a consequence of this, the secondary spermatocytes contain 14 and 12 chromosomes respectively. But, these abnormal spermatocytes show a tendency towards degeneration as evidenced by pycnosis. Obviously further development of this is abortive and viable sperms are not produced.

The interest of the present study concerns also the fact, that while in all the species of Fulgoridae so far studied there is an XO (male) type of sex-determining mechanism, in these species of *Eurybrachis* there is an XY (male) type of sex-chromosome mechanism. This poses a very fascinating question regarding the origin of XY type of sex-chromosome mechanism in this genus in particular and the evolution of the sex determining mechanism in Homoptera in general.

#### 19. Chromosome studies in three species of Homoptera.

S. R. V. RAO, Pilani.

The present study concerns the chromosomes of *Pyrilla* belonging to the family Fulgoridae, *Oxyrachis* and *Leptocentrus* both belonging to the family Membracidae. The diploid number in these species are 27, 21 and 21 respectively and in all these species there is an XO type (male) of sex determining mechanism. In the first meiotic division in all these species the X-chromosome occupies an isolated position away from the group of autosome bivalents on the metaphase plate. Further during anaphase I, in *Pyrilla* and *Oxyrachis* the X-chromosome lags behind the autosomes. This phenomenon is, however, not noticed in *Leptocentrus*. The secondary spermatocytes, therefore, are of the two types some containing the X-chromosome and the others without it.

20. Studies on the sympathetic nervous system of reptiles : Cytoplasmic inclusions of the sympathetic neurons of the garden lizard, *Calotes versicolor* and the limbless lizard, *Barkudia*.

C. C. NARASIMHAMURTHY and KANDULA PAMPAPATHI RAO,  
Waltair.

The golgi apparatus of the sympathetic neurons of the two species of lizards seen in silver and osmium impregnated preparations, appears as a peri-nuclear reticulum at the height of its development. In younger individuals having relatively young neurons, the apparatus is unipolar, being usually confined to the cytoplasm at the axon pole of the nucleus. In old and senile individuals the neurons contain a much broken up canal system widely scattered in the cytoplasm which never reaches the cortical area. A comparison of the present observations with those of the earlier studies of other investigators on the neurons of amphibia, birds and mammals, suggests that the golgi apparatus of the sympathetic neurons of the Reptilia is perhaps unique and remarkable in retaining the polarised condition in at least some nerve cells of the young adults, whereas all other studied vertebrate material exhibited such polarity only in the embryonic condition.

Our observations on the occurrence and distribution of pigment granules are found to support the argument against an origin of the golgi material from sudanophile pigment granules.

The mitochondria of these cells are typical of vertebrate neuron in being scattered granules in the cytoplasm and reaching their maximum concentration in and around the cortical areas.

### EMBRYOLOGY

21. Observations on the Development of the Chondrocranium in *Vipera*.

H. R. SRINIVASACHAR, Bangalore.

A stage in the development of the chondrocranium in *Vipera russelii* (4.2 mm. head length) has been described and compared with similar stages of *Ptyas* (7.5 mm. head length) and the cobra (4.3 mm. head length).

In the stage examined, the basal plate, the auditory capsules, the trabeculae and the nasal capsules are formed. The nasal capsules are not however, completely chondrified. The trabeculae are not very much elongated as in other snakes. The two trabeculae run close together in front of the fenestra hypophyseos without fusing upto the trabeculae communis. The trabeculae posterior to the hypophysial fenestra and laterally to the crista sellaris make a deep arch before uniting with the basal plate laterally. This indentation is probably made possible by the development of the polar cartilages between the trabeculae and basal plate. The orbital cartilages are noticed on the dorsal region of the trabeculae extending to about 250 micra. There is no interorbital septum either membranous or cartilaginous and the chondrocranium therefore conforms to the platytrabec type. Each auditory capsule is separated posteriorly from the basal plate by means of a wide fissure,—the fissura metotica.

The mandibular arch is represented dorsally by quadrate and ventrally by the cylindrical Meckel's cartilages, which however, do not fuse anteriorly.



22. On the development of the notochord and the vertebral column in the Cyprinodont, *Oryzias melastigma* (McClelland).

H. K. MOOKERJEE, D. N. GANGULY and T. P. CHATTERJEE,  
Calcutta.

The present work is undertaken to find out the exact mode of the formation of the notochord in Cyprinodont, *Oryzias melastigma* (McClelland) considering that our present knowledge of the exact formation of the notochord in teleost fishes is extremely vague. The work is further extended to find out whether the basic principles as shown by Mookerjee and his collaborators (1940-53) are followed even in *O. melastigma*. The following observations are recorded:—

1. Anterior portion of the notochord develops from the dorsal wall of the archenteron, and is, therefore, endodermal in origin.

2. Posterior portion of the notochord is developed from the dorsal lip of the blastopore after the formation of the median streak, and is, therefore, ectodermal in origin.

3. The anterior continuation of the notochord is transformed into a styliform structure which is cartilaginous in the adult.

4. There are two notochordal sheaths secreted by either the notochord itself or its epithelium. The inner sheath is absent in the mid-vertebral region. The non-vacuolated notochord directly ossifies, without passing through the stage of chondrification. It forms a bony structure (mid-vertebral disc) and becomes homogeneous with the bony outer perichordal ring laminated by elastica externa.

5. The sheaths and also the notochord take part in the formation of the vertebral centrum. The centrum is formed by the aggregation of skeletogenous layer as perichordal tubes in the form of two concentric rings around the notochordal sheaths.

6. A deposition of the skeletogenous cells as the plastering substance around the perichordal tubes is observed.

7. The basidorsals and interdorsals co-ossify to form the neural arch. The roof of the arch is completed by the intervention of the third elements, namely the supradorsal and the dorso-interdorsal. The supradorsal is 'v' shaped, bony and postero-dorsally inclined. The interdorsals are fibrous in nature and are lost in the prepared skeleton due to their non-bony condition.

8. The haemal arches are also made up of the basiventral and interventrals and are completed by the infraventral and the infrainterventrals. The fibrous infraventrals are lost in the prepared skeleton like the dorso-interdorsals.

9. Both the postero-dorsally and postero-ventrally directed pieces of supradorsal and infraventral serve as the neural and the haemal spines respectively.

10. The pre- and post-zygapophyses are formed from the anterior and posterior interdorsals respectively.

11. Both diapophysis and parapophysis are present in connection with the neural and haemal arches in all the precaudal vertebrae. In the intravertebral region they co-ossify to form a homogeneous bony mass. They are membrane-bony structures and found to be developed as mesenchymatous aggregations.

12. Two types of ribs are present in *O. melastigma*, a dorsal and a pleural. The dorsal rib remains attached to the diapophysis and the pleural rib to the parapophysis. Both the ribs develop as cartilaginous structures whose perichordium becomes ossified.

13. In addition to the conventional articulation of the vertebral column with the skull, the continuous perichordal tube, binding material, continuous notochord and the superior dorsal ligament, two heavy zygapophyses of the first, and the occipital vertebrae serve as firm articulating areas.

14. Intervertebral ligament is formed by the secretion of the notochordal epithelium of the intervertebral region.

15. The development of the vertebral column in *O. melastigma* follows the basic plan as shown by Mookerjee and his collaborators (1940-53).

### 3. Peculiar Amniogenesis in *Cynopterus sphinx geneticus* (Anderson).

M. A. MOGHE, Pilani.

The amnion in megachiroptera is formed by cavitation. A cavity appears in the embryonic mass and this is the definitive amniotic cavity. The floor of the cavity is formed by embryonic ectoderm which later thickens to form the ectoderm plate. This occurs in *Pteropus* and *Xantharpya* and is supposed to occur also in *Cynopterus*. But in the specimen of *Cynopterus* at my disposal, though an amniotic cavity is formed in this manner it is not the definitive amniotic cavity. The ectoderm breaks and two folds appear from the lateral edges of the embryonic mass so as to form a new cavity. This new cavity is in communication with the primitive amniotic cavity. I am unable to affirm if this is the normal or an aberrant case. The modes of Amniogenesis in mammalia are discussed.

### 24. On the Morphogenesis of the Yolk-sac Gland in Chiroptera.

SINDHU MOGHE, Pilani.

It is stated by some earlier workers that the yolk-sac of Megachiroptera is transformed into a gland-like structure resembling that of internal secretion. But the nature of this secretion has not been stated. While the yolk-sac transforms into a gland-like structure in Megachiroptera, it does not do so in all the species of Microchiroptera so far described. Recently however, it has been reported that in two species of Microchiroptera viz., *Rhinopoma kinneari* (fam: Rhinopomidae) and *Taphozous longimanus* (fam: Emballonuridae) the yolk-sac undergoes a similar change during development.

Examination of the gland in these two sub-groups of Chiroptera reveals differences in the structure of the yolk-sac gland. The most important difference is that whereas in Megachiroptera the lumen of the gland is completely obliterated it persists as slit-like spaces in Microchiroptera. There are other histological differences such as the nature of the endoderm and the mesoderm cells.

It should be possible to find out the character and the function of the gland, and the behaviour of the yolk-sac may throw light on the phylogeny of the two subgroups. The present paper is the first in the series of studies on the structure and function of the yolk-sac gland.

## EXPERIMENTAL ZOOLOGY

### 25. How *Pila* without protease meets its protein requirements.

(Miss) V. R. MEENAKSHI, Annamalainagar.

The mode by which the herbivorous gastropod *Pila* meets its protein requirement has been studied. The food which consists of aquatic plants like *Vallisneria*, *Hydrilla* etc., contain a good amount of free amino-acids. Leucine, Alanine, Glycine, Arginine, Asparagine, traces of Valine, Proline, and Histidine are also found in the free state in these plants. The stomach contents and the blood of the animal contain these amino acids alone in the free state. These observations prove that the animal depends entirely on the free amino-acids of the food for its protein requirements.



**26. Hormones and Secondary Sex characters in the Minnow *Hyborhynchus*.**

L. S. RAMASWAMI, Bangalore.

During a study of inducing spawning in Carps by using unsexed carp-pituitary glands, it occurred to me that the potencies of various hormone preparations could be assayed by using these to cause the secondary sex characters to manifest. In some minnows, the males develop, during the breeding season, tubercles on the snout and on the lower jaw and these disappear after the season. This would serve as an excellent end point. By injecting small doses of fresh and acetone-dried pituitary of fish, mammalian and frog pituitaries, it was possible to erupt the nuptial tubercles during the non-breeding season also.

Sex hormones were also tried on fish and interesting results were obtained, which are appended as tables.

**27. "On the Significance of the Action of the Bile Salt Sodium Taurocholate on Marine Eggs."**

J. C. GEORGE, Baroda.

The erythrocyte is the only animal cell from which it is found possible to separate the cell membrane in a reasonably normal condition. While attempting to separate ghosts of marine eggs, using the eggs of the clam *Spisula*, it was observed that a very small quantity of the bile salt sodium taurocholate, 0.1 gm. in 100 c.c. of sea water acts as an excellent lysis. The eggs swell up and within a few seconds the cell membrane ruptures at just one point, with the cytoplasm and in most cases the nucleus too flowing out, leaving the ghosts behind. With a higher concentration of the bile salt in solution, the nuclei could also be evicted practically in all cases. Ghosts thus obtained should be good material for studying the properties of the egg cell membrane before and after fertilization and also after the artificially-induced breakdown of the germinal vesicle.

The phenomenon of the formation of an outer gel, as the contents of a marine egg flow out when the egg is made to rupture, was explained by Hailbrunn as a surface precipitation reaction (s.p.r.) caused by the release of free calcium. This, however, does not happen, when the rupture is brought about by the bile salt. Even a weak soap solution brings about the lysis of the egg but s.p.r. is very soon noticed. It is nevertheless possible to obtain s.p.r. when the bile salt is used, provided the medium contains an excess quantity of calcium. The question that arises now is whether the presence of a higher concentration than normal of bile salts in blood binds the blood calcium and also whether it promotes hemolysis in hemolytic jaundice.

**28. Oxygen-carrying capacity of the blood of some crustaceans and molluscs.**

P. V. RANGNEKER, Delhi.

It is well known that in the majority of crustaceans and molluscs haemocyanin acts as an oxygen-carrier. It is also recorded that there is a proportion between the amount of copper contents in haemocyanin solutions and the quantity of oxygen with which they would combine. Taking the amount of copper in the blood as a measure of its oxyphoric power, its relative amounts per 100 c.c. of blood in the crustaceans, *Panulirus polyphagus*, *Scylla serrata*, *Paratelphusa guerini* have been determined. The values of copper content for the respective animals are 8.333 to 11.764 mgs., 6.274 to 8.627 mgs. and 6.024 to 10.606 mgs. The quality of haemocyanin is measured by the amount of copper present per gm. of the substance. Assessed from this, the paper gives the gradations in the oxyphoric powers of the blood of

rustaceans. Percentages of copper in the blood of Molluscs, *Telëscopium telescopium*, *Pila globosa*, *Paphia malabarica*, *Octopus* sp. and *Aplysia* sp. are respectively, 4.95 mgs., 1.979 to 2.432 mgs., 1.96 mgs., 18.5 to 22.95 mgs. and 3.5 mgs. From the data obtained a discussion in the light of physiology is offered.

## PROTOZOA

### 29. On the occurrence of *Stenophora* sp. in the midgut of *Blatta orientalis*.

CHANDRA BAL and BHUWAN PRAKASH RAI, Banaras.

Ray and Chakravarti have described *Stenophora khagendrae* and *Stenophora lipsoidi* respectively from the intestine of millipedes. This genus has not been described from any other arthropod in India. In smear preparations of the contents of *Blatta orientalis* we came across specimens of *Stenophora* sp. This is the first time that this genus has been described from the midgut of *Blatta orientalis*, one of the two commonly found cockroaches in India.

### 30. On the occurrence of *Opalina scalpriformis* in the rectum of *Rana tigerina*.

CHANDRA BAL and (Miss) P. V. RANJINI, Banaras.

While examining ciliates from the rectum of common Indian frog from *Rana tigerina* it was found that a frog was infected with a species of *Opalina* which, on closer examination, was found to resemble *O. scalpriformis* described by Ghosh and de Mel in *Bufo melanostictus*. Apparently this species is not of common occurrence in *Rana tigerina*. It differs in minor details from those described by the above named authors. These differences, however, do not justify its inclusion as a separate species. No other ciliates were found to occur along with this species in the alimentary canal of *Rana tigerina*. The structure has been studied and redescribed.

### 31. Cystic Viability of Soil Amoebae.

BANSIDHAR HAJRA and SIVATOSH MOOKERJEE, Calcutta.

The occurrence of alternate phase variations—trophic and cystic forms—is a characteristic behaviour of soil amoebae in the laboratory cultures. Normal cyst culture of two species of soil amoebae—*Naecleria gruberi* and *Acanthamoeba* sp.—renders active trophic forms for 2 to 3 days after which period the amoebae turn into cystic forms. A series of experiments have been made to test the power of viability of such cysts. After the lapse of a maximum period of nine months cysts have been used for a re-culture and perfect normal trophic forms resulted within three to four days. Cysts of four, five, six months old are capable of emerging into regular trophic forms.

Cysts of soil amoebae can endure such a long period of sessile life and retain the power of protoplasmic conversion from cystic to trophic nature.

### 32. Occurrence of *Diplocystis* sp. as a parasite in the haemocoel of cockroach.

H. N. RAY and B. DASGUPTA, Calcutta.

*Diplocystis* sp., an acephaline Gregarine, is recorded for the first time in India, as a parasite in the haemocoelic cavity of cockroach. The first record of this parasite was by Kunstler (1887) in Germany, who described the species *Diplocystis schneideri*.

A large number of cockroaches, collected at Calcutta, both adults and nymphal instars, was examined. Every individual was found infected.



The parasites, as they occur in the haemocoelic cavity, are fairly large in size (about 2 mm.), and cannot be easily overlooked. The trophozoite stages are however not found in the haemocoel, though gametocytes and gametocysts occur in abundance. Sporozoites are 8 in number in a single spherical spore measuring  $5\mu$  in diameter.

**33. Studies on the osmotic properties of internal parasites of poikilotherms. Observations on the behaviour of *Gregarina poecilocerum* under heterosmotic conditions.**

KANDULA PAMPAPATHI RAO and C. C. NARASIMHAMURTHY, Waltair.

Amongst the parasitic protozoa contractile vacuoles are uncommon. Even amongst these the sporozoa never have a contractile vacuole. The sporozoan parasitizing the gut of invertebrate hosts must be experiencing wide variations in the osmotic pressure of their surrounding media and the assumption that considerable exchange of water and salts between the interior of the parasite and the external medium takes place, is justified. Besides Adcock's (1940) no data are available in this regard. We have observed the volume changes of *Gregarina poecilocerum* from the gut of the grass hopper *Poecilocera picta*, when subjected to different osmotic stresses by transferring individual gregarines to NaCl solutions of varying percentages, from 2.5 to 5.0%, corresponding to a molar concentration range of from 0.425 to 0.86.

No significant volume changes were observed in gregarines kept in 0.825 M (4.75%) NaCl over extended periods. But in more dilute (hypotonic) solutions there was an initial swelling followed by a return to the original normal volume. Likewise, in more concentrated (hypertonic) solutions there was an initial shrinkage followed by a return to the normal volume, thus exhibiting osmotic adjustment with volume regulation in both hypo- and hypertonic media. This capacity to adjust osmotically through volume regulation suggests a permeability to salts in both directions.

## HELMINTHOLOGY

**34. On a new species of the genus *Lutztrema* Travassos, 1941.**

P. N. CHATTERJI, Cuttack.

In this paper a new species of the genus *Lutztrema* Travassos has been described. This species was collected from the liver of a spurwinged Plover, *Haplopternis ventralis*. The new species has been compared with other similar forms and its validity has been discussed. In India this genus is represented only by four species. Here the description of the fifth species is added.

**35. Studies on the biology and life-history of *Ascaridia galli*, Schrank, 1788.**

P. G. DEO and H. D. SRIVASTAVA, Izatnagar.

In this paper are incorporated the results of experiments on the biology and life-history of the large roundworm of poultry, *Ascaridia galli*. The synonymy of *A. lineata* (Schneider, 1866) with *A. galli* (Schrank, 1788) has been discussed. The eggs of the parasite develop in six days to the embryonated stage in nature at  $33^{\circ}\text{C}$ . to  $33.6^{\circ}\text{C}$ ., when kept in cultures of aerated distilled water, tap water and normal saline, to which about ten drops of two per cent formalin are added. At  $22^{\circ}\text{C}$ ., they take sixteen to eighteen days for embryonation. They do not develop below  $12^{\circ}\text{C}$ . but remain viable for a long time. At or above  $40^{\circ}\text{C}$ . they die.

After reaching the intermediate developmental stages. Oxygen was found to be essential for their development.

The birds acquire the infection by swallowing infective embryonated eggs. The larvae undergo three moults before reaching maturity. The first moult takes place between six and eight days, while the second and third occur within fourteen to fifteen and eighteen to twenty-one days respectively after the initial infection. The migration of the larvae into the intestinal mucosa between tenth and eighteenth day was infrequent. The larvae attained maturity in twenty-eight to thirty-four days after infection in four to eight weeks old chickens.

### 36. A revision of the genus *Ornithobilharzia* Odhner, 1912. (Trematoda: Schistosomatidae).

S. C. DUTT and H. D. SRIVASTAVA, Izatnagar.

The genus *Ornithobilharzia* created by Odhner (1912) for some avian schistosomes and in which have subsequently been included several other species of avian and mammalian schistosomes, has been critically reviewed and revised.

The mammalian schistosomes *Ornithobilharzia bomfordi* (Montgomery, 1906), Price, 1929, (Syn. *Schistosoma bomfordi* Montgomery, 1906), *O. turkestanicum* (Skrjabin, 1913), Price, 1929 (Syn. *Schistosoma turkestanicum* Skrjabin, 1913) and *O. dattai* Dutt & Srivastava, 1952, have been shown to possess very distinct morphological differences from the avian schistosomes included in the genus *Ornithobilharzia* Odhner, 1912. The morphological differences together with the difference in the definitive host specificity have necessitated the separation of the three species in question from the genus *Ornithobilharzia* and the creation of a new genus *Orientobilharzia* for them with *Orientobilharzia dattai* (Dutt & Srivastava, 1952) n. comb. as the type species. In its number of testes *Orientobilharzia* resembles *Ornithobilharzia* and *Bivitellobilharzia* but it can be easily distinguished from the former by the shape of its ovary which is ovoid and from the latter in having a single set of vitellaria. The diagnostic characters of the new genus are: (1) males with large number of testes (37-80), (2) females with an ovoid ovary and one set of vitellaria and (3) occurrence exclusively in mammals.

The mammalian schistosome *Ornithobilharzia nairi* (Mudaliar & Ramanujachari, 1945) Bhalariao, 1947, (Syn. *Schistosoma nairi* Mudaliar & Ramanujachari, 1945) has been transferred to the genus *Bivitellobilharzia* Vogel & Mining, 1940, as *Bivitellobilharzia nairi* (Mudaliar & Ramanujachari, 1945) n. comb. A new genus, *Sinobilharzia* has been proposed for the avian schistosome *Ornithobilharzia odhneri* Faust, 1924, with *Sinobilharzia odhneri* (Faust, 1924) n. comb. as the type species. *Ornithobilharzia hoepplii* Tang, 1951, has been transferred to the genus *Microbilharzia* Price, 1929 as *Microbilharzia hoepplii* (Tang, 1951) n. comb.

### 37. Studies on the life history of *Hymenolepis farciminosa* (Goeze, 1782), a tapeworm of crow and collared myna.

S. C. DUTT and K. N. MEHRA, Izatnagar.

Life history of *Hymenolepis farciminosa*, a tapeworm of crow and collared myna, has been worked out for the first time. The grasshoppers, *Acrotylus humbertianus*, *Acrida exaltata*, *Oedaleus abruptus* and several other species have been experimentally incriminated as the intermediate host of this parasite. Gravid segments of it were fed to clean grasshoppers. The egg developed to the cysticercoid stage in 7 days. The cysticercoids measured from 300-385 microns  $\times$  154-242 microns. The rostellar hooks, ten in number, measured 23 microns. The suckers were unarmed. The tail was present in most of the cysticercoids. The maximum size of the tail was 908 microns. Embryonal hooks were



present in the tail. The number of cysticercoids recovered from one grasshopper varied from one to 340 with an average of 85. The cysticercoids were fed to a clean pigeon and a crow, *Corvus* sp. The pigeon failed to take up the infection while the crow passed the gravid segments and on post-mortem was found to be harbouring mature specimens of *H. farciminosa*.

**38. Studies on the life history of *Hymenolepis fraterna* (Stiles, 1906), a tape-worm of rat.**

K. N. MEHRA, Izatnagar.

The intermediate host of *Hymenolepis fraterna* was not known in India. The life history of this tapeworm has now been worked out. The common grain beetles *Tribolium confusum* Duv. and *Latheticus oryzae* Water and their larvae have been found experimentally to act as the intermediate hosts of the parasite. *L. oryzae* has been recorded for the first time as the intermediate host. The egg developed in 5-6 days upto the cysticercoid stage within the body cavity of the intermediate host. The cysticercoids measured 142-171 microns  $\times$  100-141 microns. White rats become infected when they were fed on the cysticercoids. The eggs of the parasite when administered to white rats also produced the infection. Thus the life history of the parasite is both direct and indirect.

The incidence of natural infection of house rats with the parasite was also studied. Out of 21 house rats, *Rattus* sp. killed for autopsy, five (23.8%) were found to be infected. The number of worms per rat varied from 1-16, the average was 5.6.

**39. Studies on the life history of *Hymenolepis diminuta* (Rud., 1819), a common tapeworm of rat and man.**

K. N. MEHRA, Izatnagar.

No work on the life history of *Hymenolepis diminuta* had been done in India. In this paper the life history of *H. diminuta* has been elucidated. Developmental larval stages from the onchosphere to the fully developed cysticercoid stage have been obtained from experimentally infected common grain beetle *Tribolium confusum* Duv. and described. Out of 94 infected beetles, 8 (8.5%) were found to be positive. The larvae of the beetle proved to be more susceptible to the infection than the adults. Out of 41 infected larvae, 23 larvae (56.1%) were found to be positive. The larvae of the parasite developed to the cysticercoid stage in beetle larvae, unlike *Dipylidium caninum* where the cysticercoids develop only after the flea larvae metamorphose into the adult stage. The egg developed in 9-12 days upto the cysticercoid stage within the body cavity of the intermediate host. The cysticercoids measured from 185-442 microns  $\times$  128-256 microns. The maximum size of the tail was 700 microns. The faeces of the white rats became positive for the ova of *H. diminuta* in 19-22 days after being infected with the cysticercoids.

*T. confusum*, *Latheticus oryzae* Water and *Opatroides vicinus* Fairm. have been determined experimentally as the new intermediate hosts of the parasite. Species of several genera of grass-hoppers have been incriminated as the intermediate host of the parasite for the first time.

**40. *Cercaria ratnagiriensis*, N.Sp., A Megalurous *Cercaria* from *Paludomus obesa* (Philippi).**

C. T. PETER and H. D. SRIVASTAVA, Izatnagar.

Out of a large number of specimens of *Paludomus obesa* collected from a rivulet in the village Gimvvi in Ratnagiri District (Bombay State), eight were found to

infected with a new species of megalurous cercaria, *Cercaria ratnagiriensis*, sp., which is described in this paper.

The features which distinguish the new larva from the other known members of the group are the presence of a clump of 10 rod-shaped granules placed anterior to a cluster of 8 cells that are arranged around the funnel-like invaginated structure at the tip of the tail, 8 pairs of penetration gland openings armed with spines, 12 pairs of flame cells and a well-differentiated genital system. The cercariae encyst readily in the open with the formation of globular cysts.

*C. ratnagiriensis* is the second Indian species of the "Megalura" group, the other being *Cercariae indicae* in Sewell, 1922.

# 1. Echinostome Cercariae from Bareilly, with the Description of a New Species.

C. T. PETER, Izatnagar.

*Indoplanorbis exustus* was the only snail species among the locally available ones found discharging echinostome cercariae. So far, only three species of echinostome cercariae have been encountered in Bareilly, of these one proved to be the larva of *Artyfechinostomum sujaratyfex* Lane, 1915 and another that of *Atagifer sriastavai* Peter, 1954. The third one, whose adult is not known, is described in this paper as *Cercaria beaveri*, n.sp.

*Cercaria beaveri* presents all the characters of the "Echinata" group of Sewell, but differs from the previously known members of the group in the following features of specific significance: 27 collar spines—4 corners and 6 laterals on either side and 7 dorsals in two alternating rows, a horse-shoe shaped anterior organ on the dorsum of the body, an oesophagus composed of 9 cells and the caeca without any annulations, 8 penetration gland openings, 15 pairs of flame cells and distinct genital rudiments.

The *Cercaria* encysts in the gill-chamber of tadpoles.

# 42. *Cercaria reniforma* n.sp.—A new Monostome *Cercaria* from the snail, *Melanoides flavidus*.

PREMVATI, Lucknow.

*Cercaria reniforma* n.sp. is a Monostome *Cercaria* without fin-golds on the tail and with a pair of lateral eye-spots. It is characterised by the presence of spines on the body and the tail; the presence of two groups of penetration glands, a lateral group of seven pairs of large pyriform glands and a median group of four pairs of small rounded cells; the extension of its intestinal caeca up to the middle of the body; and the possession of a reniform excretory bladder, caudal excretory canal and six pairs of flame cells in the body. The development of these cercariae takes place in rediae which infect the digestive gland of the snail, *Melanoides flavidus*.

# 43. On the occurrence of Metacercariae cysts of a Diplostome (Trematoda) in Fresh-water Fishes.

P. N. GANAPATI and K. HANUMANTHA RAO, Waltair.

An investigation of the fresh-water carps in a fisheries pond at Samalkot has revealed that *Catla catla*, *Labeo calbasu* and *Nuria danrica* suffer from the black-grub disease. The disease which appears as black ovoid patches all over the body is due to the metacercariae cysts of a diplostome which appears to belong to the genus *Diplostomum*. Mortality rate among infected fish is high and there appears to be no correlation between the number of cysts and the length of fish.



The cysts are distributed subcutaneously with a tendency to crowd at the bases of the dorsal and caudal fins. Some of them occur in the buccal cavity, branchial chamber and on the eye. The cyst wall is composed of two layers. The outermost is a tough cellular connective tissue layer while the inner one is a thin transparent non-cellular coat. The metacercaria is characterised by an anterior spinous region in which are lodged all the organs of attachment. The oral sucker is round and on either side of this are situated lateral suckers. The adhesive organ is situated at the posterior end of the anterior region. Anterior to this is situated the ventral sucker. Rudiments of reproductive system are situated in the posterior region. The body is thus divisible into two regions by a constriction at the middle.

There appears to be no recorded occurrence of the larval forms of *Diplostomum* from India. The adults have been reported from kingfishers. The metacercariae described here might form one of the larval stages. It is probable that snails belonging to the genus *Vivipara* which abounds in great numbers in the ponds from where the infected fishes were secured act as the first intermediate hosts. Further experiments and observations are in progress with a view to elucidate the life-cycle of this parasite.

## ANNELIDA

### 44. *Haemadipsa zeylanica agilis* (Moore), A Land Leech from Nainital and Almora

M. L. BHATIA, Delhi.

Land Leeches are reported from several hilly places in India where they swarm in incredible profusions in streams, damp grass and even among the bushes so much so that it is impossible to walk a single step without being attacked by them. They creep along the ground and they are seen on every bush and tree. They have become completely terrestrial or even arboreal. The changed habitat from water to land has brought about modifications mainly in three directions (i) water relations, (ii) locomotion, (iii) receptor organs.

Integument of land leeches is harder than that of other leeches; mucous glands are numerous and their secretion maintains the skin moisture. The nephridiopores open laterally and the excretory product is used for moistening the body surface. The last pair of nephridiopores is situated beneath trilobed fleshy flange-like appendages, the *auricles*, which act as brushes on the two sides and distribute moisture over the place of attachment of the posterior sucker, facilitating movements of the body in all directions.

Land leeches are alert and keen in senses, they spring from as far as 30 ft distance to attack a person. It has been observed that their eyes (5 pairs) are relatively large, the segmental receptors are more prominent having a large number of photoreceptors which enable the worm to locate the source of light and motion of objects. The eyes are mere phototactic organs.

## MYRIAPODA

### 45. On some peculiarities of the Cuticle of Indian Myriapods.

M. B. LAL and S. C. SRIVASTAVA, Lucknow.

Blower (1951) described two layers in the myriapod cuticle. Our examination of the cuticle of *Scolopendra* sp. revealed more than two layers although epicuticle was definitely lacking. Tapered parts of the dermal gland ducts of *Thyroglutus* sp. are spirally coiled, a feature characteristic of the pore canals only.

## CRUSTACEA

46. Maturation in *Parapeneopsis stylifera* (Crustacea).

V. B. TEMBE and (Miss) F. S. SHAIKHAMAHMUD, Bombay.

*Parapeneopsis stylifera* (Edwards 1881), one of the commonest prawns of Bombay had been selected for the study of Maturation. To determine immature, maturing and mature prawns, observations were made on the following points:—

- (1) General condition of the animal, (2) General condition of the ovary, and (3) the Growth of Ova.

On the basis of the above observations it was possible to classify the ovaries into six different stages: (1) Immature, (2) Early maturing, (3) Late maturing, (4) Mature, (5) Spent and (6) Regenerating.

The occurrence of the mature, maturing and immature prawns throughout the year, the study of their intraovarian eggs and the stages of maturity indicate that they breed continuously in this habitat.

## ARACHNIDA

## 47. A New Species of Trombiculid Mite from a rat snake in Bombay.

S. RAMMOHAN RAO and L. S. HIREGAUDAR, Bombay.

*Fonsecia ptyasi* n.sp. has been described from a rat snake in Bombay. It closely resembles *F. columberina* but differs from it in the possession of a single ocillus instead of two and transparent areas on the scutum. Besides the antero-medial seta is placed slightly anterior to the antero-lateral ones, unlike in *F. columberina*.

48. A note on the campaniform sense-organs in *Hyalomma savignyi*.

B. DASGUPTA, Calcutta.

Campaniform sense-organs have been described from different insects, but their presence in the tick *Hyalomma savignyi* does not seem to have received attention before. Entire specimens were sectioned according to the method described by Ray and Bhattacharya (1948) and the morphology of these sense-organs was studied. Existence of special sense-cells and large epidermal cells was noted. The latter were specially noteworthy. These were chitogenous in function, contributing to the formation of the membrane of the sense-organs, and appeared as irregular-shaped huge cells with branched nucleus. One or several nucleoli were found in the nucleus. The cytoplasm was invaded by big vacuoles.

The entire structure consisting of the sense-cells and epidermal cells projected beyond the hypodermal cells of the body-wall and lay suspended into the haemocoelic cavity. In fully engorged ticks these got compressed against the body-wall and looked smaller, due to pressure exerted by the highly distended gastric caecae.

49. Observations on Rickettsia-like bodies in *Hyalomma savignyi*.

B. DASGUPTA and H. N. RAY, Calcutta.

In a batch of *Hyalomma savignyi* reared in the laboratory all the individuals were found to be harbouring Rickettsia-like bodies first reported by Cowdry in 1925 in other ticks.



In immature eggs these micro-organisms lay scattered in the cytoplasm while in mature eggs they were found aggregated at one place. They were found both in engorged and in unfed adults but were not noticed in larvae. No arrest of development of the eggs occurred due to the presence of these micro-organisms which seemed to live in symbiotic relationship with the host and were apparently transmitted hereditarily.

#### 50. The Feeding Mechanism of *Histiostoma polypori* (Oud.) (Acari).

BASANTA KUMAR BEHURA, Cuttack.

The oral aperture is bounded dorso-laterally by the saw-shaped chelicerae, ventrally by the fused bases of the pedipalps and dorsally by the palpal membranous expansions which form part of the funnel over the "rostrum". The lingua arises from the floor of the mouth.

The buccal cavity is distinguishable from the pharynx by the absence of attached muscles.

The lumen of the pharynx is U-shaped in cross-section.

The oesophagus at its entrance into the fore-gut forms a large funnel-shaped structure which projects conspicuously into the cavity of the mid-gut. Although the oesophagus is a somewhat straight tube, in some specimens it is curved and forms a U-shaped loop before piercing through the nervous mass.

From the posterior lateral corners of the fore-gut are given off a pair of gut caeca. The walls of the fore-gut and colon consist of a single layer of cells with large nuclei and very granular cytoplasm.

The upper portion of the rectum is spherical and consists of a single layer of columnar epithelial cells which post-ventrally become flattened.

*Histiostoma polypori* is literally immersed in the liquid food material while feeding. The alternate saw-like action of the chelicerae tears the cell-walls of the decaying plants and animal remains. The beating flagella of the pedipalp set up a current of liquid food which flows steadily into the oral aperture of the mite.

#### 51. Scorpion heart and its physiology.

M. S. KANUNGO, Cuttack.

Scorpion heart can be dissected out and kept active for nearly 12 hrs. in a solution of pH 6.3 containing NaCl-0.65 gms., KCl-0.03 gms., and CaCl<sub>2</sub>-0.03 gms. in 100 c.c. of distilled water. The bulbular heart is on the dorsal side between the two lobes of the liver. In the said solution it keeps beating at a rate of 56-58 per minute with its anterior and posterior ends contracting and relaxing simultaneously. This slow rate is due to the rather inactive life of the scorpion. On treatment with Acetylcholine in different dilutions the rate of heart beat slowed down, the time taken being inversely proportional to the dilutions of the drug. Different dilutions of Histamine accelerated the heart beat till a maximum of 85. A heart collapsing under the influence of Acetylcholine could be revived by Histamine. The inhibition of the heart by Acetylcholine and its acceleration by Histamine shows its myogenic nature.

#### 52. Reaction of Arachnid cuticle to some Chemical Reagents.

M. B. LAL, and S. C. SRIVASTAVA, Lucknow.

Krishnan (1953) claimed the presence of a thin epicuticle in the cuticle of *Palamnaeus swammerdani*. Our studies on the action of mineral acids on the

cuticle of *Palammacus bengalensis* and *Buthus tamulus gangeticus* revealed a well differentiated epicuticle formed of two layers which could be further confirmed with Sudan IV. The exocuticle was most susceptible to the action of alkali. While positive Biuret, Xanthoproteic, Millon's, Morner's and negative Aldehyde and Romieu reactions showed tyrosin-rich nature of the proteins impregnating the cuticle. The action of Millon's reagent brought strikingly well into picture the pore canals revealing their helical nature at best. Action of Fontana's fluid and Mallory's stain showed a comparatively advanced cuticle in so far as the process of hardening and sclerotization is concerned.

## ENTOMOLOGY

### 53. Studies on symbiotes occurring in the mid-gut epithelium of *Ctenolepisma longicaudata*.

B. DASGUPTA, K. SENGUPTA and H. N. RAY, Calcutta.

Symbiotes with spherular bodies were observed in the epithelium of the mid-gut of *Ctenolepisma longicaudata*. These were apparently different from those of rod shaped forms described by Cowdry (1923) as occurring in the intestinal epithelial cells, fat cells and between the fibres of nerve-ganglia in a specimen of *Lepisma saccharina*.

The symbiotes occurred in abundance at the distal part of the epithelial cells. They were also found to occur singly or in groups in the lumen of the mid-gut, mixed up with the food-matters.

Host specimens when subjected to Gomori's technique for alkaline phosphatase, yielded an interesting result, i.e., the strongly positive reaction in symbiotes stood in sharp contrast to the host tissues. Under high magnification it was noticed that a minute dot in the centre of the body of the symbiote was free of cobalt sulphide deposit.

Materials stained with Unna-pappenheim stain showed that the vast majority of the symbiotes took up methyl-green stain, while a few took up pyronine stain. Only a minute central dot was free of any such reactions.

### 54. Some External Insect Parasites of Rats in Bombay.

P. J. DEORAS and K. V. TONPI, Bombay.

Insect parasites of *Rattus rattus*, and *Bandicota bengalensis*, were collected over the last twelve months. Out of 815 rats examined, 1289 fleas, 82 mites, 15 house, 18 psocids, and 1 tick were recovered. The analysis of the results from the point of view of Plague epidemiology indicates that only *X. cheopis*, and *X. astia*, are found on these rats, and that *X. cheopis* is predominant on *Rattus rattus*, and *X. astia* on the other rat. In the total collection more males of *X. cheopis*, and more females of *X. astia*, have been recorded. No *X. brassiliensis* was collected. The findings are in keeping with those of Webster and Chitre (1930). These authors had collected the data after bagging the cages, while here the collections were made from rats liberated at one place.

### 55. Anatomy of the termite, *Odontotermes redemanni* (Wasmann).

D. MUKERJI and BARUNDEB BANERJEE, Calcutta.

This paper is continuation of studies on *Odontotermes redemanni* (Wasmann) by Mukerji and Roychoudhury (1942, '43) and Mukerji and Mitra (1948, '49).



The mouth-parts of *O. redemanni* Wasmann were investigated to study the distribution of sensory hairs and musculature in different castes in close reference to the feeding habit. The mandibles of the de-alated queen are not used for biting but for passing on the food regurgitated by the worker caste in feeding her. The mandibles of sexual pair are more or less similar but different from worker and soldier castes. The first and the second maxillae differ in different castes in structure and in the distribution of hairs.

The reproductive organs of females in *Termes obscuriceps* and *O. redemanni* are given respectively by Bugnion (1912) and Ahrens (1935). The latter reported the formation of corpus luteum. In this paper the formation of corpus luteum is confirmed and the structure in alated and de-alated sexuals is given with histological details.

**56. Cephalic morphology, mouth parts and the anatomy of Silver fish, *Ctenolepisma longicaudata* Esch (Thysanura).**

D. MUKERJI and K. SEN GUPTA, Calcutta.

The morphology of the head, the mouth parts and the anatomy of common Indian Silverfish *C. longicaudata* are investigated and compared with previous descriptions.

In the labium, there is no sutural line between the mentum and the submentum, but the two are demarcated by a row of setae. Presence of compound eyes with twelve facets has been recorded.

The crop is comparatively very large in size and the gizzard well developed with six strongly chitinous teeth. Malpighian tubules are four in number.

In the male reproductive system, seminal vesicle is highly glandular and much enlarged. The male ducts retain their primitive paired nature but immediately before the external opening, form an extremely short common duct which opens by a single pore.

The female reproductive organs conform to the structures reported by previous workers.

**57. Morphology and anatomy of the cigarette beetle, *Lasioderma serricornis* (Fab.).**

D. MUKERJI and M. N. DEY, Calcutta.

In this paper morphology and internal anatomy of the beetle *Lasioderma serricornis* (Fab.) are described. The species is found in Calcutta infesting stored turmeric which are damaged by the tunneling of the imago and larval stages. Peculiarities are noted in the thorax and in the structure of the mouth-parts. Alimentary and reproductive systems are also described.

The labium bears a single piece anteriorly, the ligula has a new type distribution of sensory hairs. The pronotum is a single piece, crescentic in shape and overlaps the head. The abdomen is highly reduced. A pair of diverticula arises from the crop which is peculiar to this species.

The seminal vesicle is a small chamber with a pair of lateral diverticula containing sperms. The spermatheca is provided with a hypodermal gland.

**58. A comparative study of the mouth-parts of ants.**

D. MUKERJI and S. K. DAS GUPTA, Calcutta.

The morphology of the mouth-parts of 35 species of ants (Family Formicidae) belonging to 23 genera of 5 different subfamilies was studied on a comparative basis.

The mouth-parts varied in the following way :

1. Labrum ... in shape and in hairs on it.
2. Mandibles ... in number of teeth and in hairs on them.
3. Maxillae ... in hairs on the different parts, in number and length of the segments of the maxillary-palp.
4. Labium ... in hairs on the different parts and in number and length of the segments of the Labial-palp.

These variations have been discussed in the paper with reference to the feeding-habits and taxonomy.

**59. Preliminary note on the life history of *Amsacta lactineus* (Cram), a pest of groundnut (*Arachis hypogea*).**

P. SEN and AMAL BHUSAN MUKHERJEE, Calcutta.

The female moth lays about 200–230 eggs on the lower surface of the leaf of groundnut plant in 6 or 7 batches in course of a day, usually during the afternoon. The number of eggs laid at a time varies from 11 to 65. The egg is more or less spherical, whitish, and measures 0.6 to 1.0 mm. in diameter. The egg stage lasts for 4 to 6 days in July–August. The egg hatches out into a minute larva measuring about 3 mm. in length and 1 mm. in breadth. The full-grown larva with long hairs measures 35.5 mm. long and 7 mm. broad and looks blackish brown. The larval head is reddish or orange-coloured. The larva takes about 27–30 days to transform into the pupa. The pupa is enclosed in a case formed from the exuviae of the last larva, and this stage lasts for 13–16 days. The whole life-cycle is completed in about 45 days during summer.

**60. Adaptive Coloration and Camouflage of the common Membracid, *Otinotus oneratus* walk. (Homoptera).**

BASANTA KUMAR BEHURA, Cuttack.

*Otinotus oneratus* Walk., infests a large number of species of plants in Orissa, Bengal and Bihar. During May to October, the nymphs and adults occur in plenty. The membracid is closely attended by the ant *Camponotus* (*Tanaemyrmex*) *compressus* Fabr. During winter i.e., from November to March, the nymphal stages are rarely seen though the adults persist. The membracid is not attended by the ant during this period. The general coloration of the mature form shows cryptic coloration with the twig, and the spiny pronotal processes of the membracid, as the insect rests on the axils of plants, appear like thorns or some spiny projections of the host-plants. When the ants leave the membracids, heightening of cryptic resemblance occurs and the dense brown color of the body and wings as well as the processes of the pronotum, changes to the distinct pale tawny color of the drying thorns or spines of the host-plant. The rhythmic activity of the ant appears to have its effect on the seasonal history of its ant cattle *O. oneratus* as indicated by the change of color of the membracids with non-attendance of ants. The coloration of *O. oneratus* is cryptic and the change of coloration is only incidentally correlated with the seasonal history and attendance and non-attendance of the ant *C. compressus*.

**61. Some observations on the mounds of the termite *Odontotermes obesus* (Rambur) [Isoptera].**

H. S. VISHNOI, Delhi.

Termite mounds have been previously described by several workers (Annan-dale, 1923, 1924; Beeson, 1941; Deoras, 1949; Roonwal and Gupta, 1952; etc.).



Many interesting observations have been made recently on nearly forty mounds of *Odontotermes obesus* var. *oculatus* (Loc. Dhampur, West U.P.). The general location of the mounds, variations in number and size of buttresses, internal structure of the mound, location and the structure of the royal cell have been described. The royal cell was found usually at the centre or on any one side of the base excepting the N-W quadrant. The NS direction of the queen in her cell agrees with the similar observation made by Deoras. One live mound was peculiar in having two royal cells in its fungal chamber, one situated near 4 inches above the other. In addition to the usual tiny holes, the walls of both the royal cells had one large opening wide enough for any transit of the royal pair. A possibility of the transportation of the queen (Mukerji and Raychaudhury 1942) is supported by this case in which both the royal cells were found vacant.

Certain mounds dug out in the last few days of the month of June 1954, showed no trace of winged forms though the swarming period was just ahead. From other mounds only about a dozen alates from each could be recovered.

Though several types of termitophiles have been reported from termite mounds, Collembolans are the only forms available in the present study.

Because of the wide variations a much more extensive study of the biology of this termite is necessary.

## 62. Coupling apparatus and its bearing on the relationship of insects.

G. L. ARORA, Hoshiarpur.

A detailed study of the wing coupling mechanism has been made in insect representatives of the orders Neuroptera, Mecoptera, Hymenoptera, Diptera, Trichoptera, Lepidoptera, Orthoptera and Plecoptera. It has been found that the Panorpid insects (with the exception of Diptera) and the Hymenoptera possess some sort of a coupling apparatus, while the Orthopteroid insects do not possess any such mechanism. From the examination of these coupling structures and their comparison with one another, it has been possible to conclude that the Hymenoptera can be grouped with the Panorpids and that both the Panorpids and the Hymenoptera have descended from a common ancestral stock. Further, that the Panorpid insects and the Hymenoptera differ widely from the Orthopteroid insects and consequently cannot be said to be related to them.

## 63. Laboratory and field tests for the control of *Eupterote mollifera*.

M. B. NAIDU and S. H. ZAHEER, Hyderabad-Deccan.

Investigations on the comparative toxicity of various well known insecticides in the form of dust and spray for the control of *Eupterote mollifera*, a serious pest on *Moringa pterygosperma* (drum stick plant) were carried on both in the laboratory and the field.

Under laboratory conditions it was observed<sup>2</sup> that 10 per cent DDT and 10 per cent Gammaxene in talc caused cent per cent mortality in 48 hours in the earlier stage larvae; while the percentage of mortality was very low in the case of the advanced stage larvae. In the field, however, dusting was found to be not much effective.

When sprayed, 1 per cent pyrethrum was quicker in action in the laboratory than in the field. Although 8 per cent DDT and 8 per cent Gammaxene in kerosene oil caused cent per cent mortality in 24 hours in the laboratory the rate of mortality was low in the field. Whereas, a mixture of DDT 8 per cent and pyrethrum 0.2 per cent in kerosene oil was found to be highly toxic to the larvae in the field.

4. **Some observations on the biology of *Hippobosca* species with special reference to the pupal period.**

P. BALARAMA MENON, Izatnagar.

Observations on the length of the pupal period in *Hippobosca maculata* Leach and *Hippobosca capensis* Olfers were conducted and it was found that the pupal period is mainly dependent on the temperature, it being short during summer and much prolonged during winter seasons. When the temperature varied between 60°F and 93°F it took nineteen days for the adults of *H. capensis* to emerge from the pupa, whereas when the temperature dropped down between 59°F and 80°F it took 74 days.

5. ***Centrodora* sp. (Hymenoptera : Encyrtidae) parasitising eggs of Tabanidae in Rajasthan.**

P. BALARAMA MENON, Izatnagar.

*Centrodora* sp. is recorded for the first time as a parasite of the eggs of *Tabanus* flies in India.

During a survey of Rajasthan to study the incidence of surra and *Tabanus* flies in the area, it was noticed that some of the egg masses collected from Jaipur were parasitised by small hymenopterous insects. These parasites were different from species of *Telenomus* commonly found in certain areas of Uttar Pradesh and have been identified as *Centrodora* sp. belonging to the family Encyrtidae. It has been possible to breed these parasites into adults in the laboratory when the infected egg batches were kept in a moist chamber. The possibility of its utilisation in the control of *Tabanus* flies is suggested.

56. **Studies on the seasonal incidence of insects and other arthropods of livestock.**

P. BALARAMA MENON, Izatnagar.

These studies relate to the observations made on the seasonal incidence of arthropods of livestock at Izatnagar-Bareilly (U.P.). A detailed and systematic survey of all arthropods of veterinary importance has been made, and their seasonal incidence in relation to the meteorological record for the period has been obtained.

A total of 38 species belonging to 28 genera were encountered during the investigation. Of these, 21 species belonged to the Order Diptera, 6 to Mallophaga, 4 to Anoplura, 1 to Siphonaptera and 6 to Acarina. The results, when correlated with the meteorological data for the same period, show that most of the species are subject to seasonal variations influenced by temperature, humidity and rainfall. *Hippobosca maculata*, *Haematopinus tuberculatus* and *Boophilus australis* show a decline in their densities after heavy rains. Whereas a rise in temperature seems to have an adverse effect on the abundance of *Stomoxys calcitrans*, *Lyperosia exigua* and *Bovicola caprae*.

In some species no marked seasonal variations were noticed and no correlation of abundance with the fall of rain or temperature has been observed. No definite seasonal activity is noticeable in the case of *Hippobosca capensis*, *Philacmatomyia insignis*, *Bovicola ovis* and *Rhipicephalus sanguineus*. Some species were present throughout the year in varying numbers, whereas certain others were absent during particular seasons.

67. **Respiratory system of *Gryllotalpa africana* Beauvois (Orthoptera).**

R. RAKSHPAL, Lucknow.

There are ten pairs of spiracles: two pairs thoracic and eight pairs abdominal. The thoracic spiracles have an external closing apparatus, but the working of the



spiracles of the two segments is different. The abdominal spiracles have an internal closing apparatus. The spiracular trachea divides into three branches: dorsal, ventral and visceral. The thoracic tracheal system is different from that of the abdominal. The dorsal longitudinal trunks are present in the thorax and abdomen, lateral longitudinal trunks in the thorax, and the ventral longitudinal trunks in the abdomen only.

**68. A study of the movement of some insect pests, through grains stored in bags.**

M. V. SHARANGAPANI and S. V. PINGALE, Mysore.

This study has revealed that the insects which either emerged from the stored grain or entered it from outside, tried to move from layer to layer of the stack. In this the downward movement was always faster and restricted to a narrower column than the upward movement.

The influence of light, moisture, air and the size of the insect on the movement is reported. The light is seen to check the spread; the higher moisture in the grain did not exercise any attractive influence but slowed down the movement; air of the type commonly encountered in the warehouses had no effect and along with the size the natural speed was responsible for controlling the movement.

On the basis of this study the present practice of using insecticides only on the outer surfaces of bag-stack is shown to be of little value.

**69. Linseed Gall Fly (*Dasyneura lini* Barnes) and its Control.**

R. L. GUPTA, Nagpur.

The Linseed gall fly is a very serious pest of linseed in Madhya Pradesh and is responsible for damaging 15 to 20% flower buds. A single female lays from 29-103 eggs on 8 to 17 buds. Incubation, larval and pupal periods vary from 2-5, 4-10 and 4-9 days, respectively. There are 4 generations during the linseed season. The following control measures are suggested:—(a) Early sown variety is less attacked than normal or late sown crop, (b) Fish oil rosin soap and crude-oil-emulsion work as good deterrents, (c) Light traps are found to be most effective. As many as 1,250 flies were trapped in a single night by a petromax in an acre area, (d) of the *Day-traps*, gur-rab and water (in the proportion of 2 oz. of rab in 10 lbs. of water) attracted as many as 14,105 flies in a single day from 8 A.M. to 5 P.M.

**70. Life history of *Lasperyresia pseudonectis* Meyr.**

R. L. GUPTA, Nagpur.

*Lasperyresia pseudonectis*, the sann-hemp shoot borer, is recorded as a major pest of sann-hemp (*Crotalaria juncea*) in Madhya Pradesh. The larva damages the top shoots which are formed into characteristic galls as a result of which the upward growth of the plant is retarded and side shoots are given out which lower the value of this fibre crop. The attack also takes place at the axils of the leaves of the main branch where a swelling is formed. There may be more than one gall in the same plant. When the crop is in bearing, the caterpillar has been found to affect the capsules also. The attack starts in the second week of July when the crop is about 15 days old and continues till the middle of October. As many as 14% of plants are attacked in normal years, though the incidence may shoot up under favourable conditions. The maximum number of galls observed on a single plant was 3. A single female laid from 169 to 225 eggs. The oviposition and the post-oviposition periods varied from 2 to 6 and 1 to 3 days, respectively. The incubation period was 3 to 4 days, larval period 21 to 33 days and pupal period from 4 to

days. Adults lived from 5 to 10 days. There are 3 overlapping generations and after October the larva remains in a quiescent stage in the silken cocoon and the moths emerge by the end of June.

# 1. Studies on the Genus *Plusia* with Special Reference to Male Genitalia (Noctuidae; Lepidoptera).

S. MUKERJI and K. KRISHNAMORTHY, New Delhi.

Following the descriptions of Hampson and comparing the species with the monotypes, nine species of *Plusia* were studied for the male genitalic characters mainly with a revisionary point of view. Similarity between the male genitalic characters of *P. orichalcea* Fabr. and *Autographa precautionis* is considerable and hence *orichalcea* Fabr. may be placed under the genus *Autographa* Hubn. Similarly, *Plusia nigrisigna* Walker may be placed in the genus *Chrysapidia* Hubn and *Plusia ambirena* Guen. under the genus *Eosophoropteryx* Dyar. *Chrysodeixis*, a generic term that was sunk along with genus *Plusia*, may be revived to represent *chalcytes* as its genotype. McDunnough's (1944) separation of *Pulsia ni* from the genus *Plusia* for his new genus *Trichoplusia* with the genotype *Trichoplusia ni* (= *Plusia ni*) is supported and the male genitalic characters of *Trichoplusia ni* var. *deserticola*, are described. It is also concluded that *Plusia confusa* may be removed from the genus *Plusia* and a new genus may be erected with *Plusia confusa* as genotype. The new generic name the authors propose in this connection is *Paraplusia* Gen. Nov. Moreover, the studies on the male genitalic characters of *Plusia pepponis*, *Plusia lunata*, *Plusia jessica* confirm their being retained under the genus *Plusia*.

# 72. The Male Genitalia of the Desert Locust *Schistocerca gregaria* (Forsk.) (Acrididae : Orthoptera).

S. MUKERJI and A. K. SHARMA, New Delhi.

Despite the fact that the male genitalia of the Acrididae had drawn the attention of eminent workers like Chopard (1918, 1920), Walker (1922), Snodgrass (1935) and Roberts (1941), the male genitalic structures of the economically important and widely distributed species *Schistocerca gregaria* (Forsk.) have not been studied in detail except by Karandikar (1942). During the course of the studies on the male genitalia of certain Indian forms of Acrididae carried out by the authors the male genitalia of the Desert Locust which occurred in N.W. India in the migrating stage were studied in detail. The male genitalia of this species of the sub-family *Catantopinae* are built on the same general plan as those of the other Acridid species. The genitalia are composed of a number of separate component parts. The epiphallus is a transverse plate with three sclerites on each side, namely the *lophus*, the *ancora* and the *lateral sclerite*. The three sclerites of each side are connected by a somewhat narrow median bridge. The *lophi* project in an antero-dorsal direction from the posterior margins of the epiphallus, while the *ancorae* and the *lateral sclerites* are more or less horizontal. The *lophi* are distinctly longer than the *ancorae*, while the *lateral sclerites* are rather variable in shape and size. The two endophallic plates are provided with a well developed gonopore process each. The shape of the gonopore processes is however entirely different from what has been indicated in Karandikar's paper (1942). Each endophallic plate is posteriorly curved in a thin sigmoid flexure which is rightly continuous with the ventral valve of the same side, there being no break between the two structures as indicated by Karandikar (1942). The two endophallic plates as well as the ventral valves posteriorly continuous with them were dissected and separated from each other. This is the first time that the two endophallic plates of any Acridid species have thus been separated from each other. The dorsal valves overlie



the ventral valves and are anteriorly united to form a dorsally produced thick structure—the arch of the dorsal valves, and these are apically serrulated. The *cingulum* is composed of a pair of anterior *apodemes*, a pair of lateral *rami* and a median dorsal *zygoma* which is posteriorly continuous with the roof of the aedeagus below which lies the arch of the dorsal valves. The roof of the aedeagus is posteriorly continuous with the sheath of the aedeagus which surrounds the apices of the dorsal and ventral valves. The rami are united ventrally below the sigmoid flexures along the median lines. The ventral lobe is a large fold with tapering ends which are movable and are attached with the lateral portions of the zygoma. Ventral to and between the endophallic plates is situated the more anterior tubular ejaculatory duct, which expands posteriorly into the much longer ejaculatory sac and this is followed posteriorly by the spermatophore sac. The spermatophore sac is somewhat deeply situated between the posterior portions of the endophallic plates.

**73. Some Physical and Physiological Factors Governing the Sex-ratio in *Bracon (Microbracon) gelechiae* Ashmead (Hymenoptera : Braconidae), a larval parasite of the Potato tuber moth, *Gnorimoschema (Phthorimaea) operculella* (Lepidoptera : Gelechiidae).**

E. S. NARAYANAN and S. Z. HAIDER, New Delhi.

It has often been observed that the sex-ratio of a parasite widely fluctuates during different seasons in the field. Brunson and other workers have reported such a variation occurring in *Tiphia popilliavora* Roh.

The results of our present investigations show that besides the biological factors there are some physical and physiological factors also which affect the sex-ratio in *Bracon gelechiae*. Among the physical factors temperature has been found to have a profound effect on the sex-ratio. Percentages of females among the adults reared through their immature stages at higher temperatures such as 30°C and 35°C are higher than those recorded at lower temperatures. Wishart has recorded a contradictory result in *Chelonus annulipes* Wesm. In our investigations it has also been found that the period of development goes on decreasing with a fall in temperature from 35°C to 20°C. This explains why the proportion of females is less at lower temperatures because a female grub which requires more food for complete development is not able to get it before decomposition of the host larva sets in.

Our experiments have also proved that higher temperatures such as 30°C and 35°C acting upon the immature stages of the parasite, cause male sterility and not female sterility. Males reared at 35°C have been found to be completely sterile. Temperatures between 25°C to 35°C acting upon the adult parasites do not produce any appreciable change in the sex-ratio of the progeny, the latter being reared at 27°C and 80% relative humidity.

Humidity and light acting upon the adult parasites have not resulted in a significant change in the sex-ratio. Results of the experiments indicate that on the whole 60% is the optimum humidity for an adequate production of females. Similarly it has also been found that the decreasing intensities of light do not inhibit mating so that there is not much difference between the sex-ratios recorded under normal light intensity or in complete darkness. In view of this result it is not possible to agree with Flanders and Peterson who have stated that light intensity has a dominating influence upon the activities of *Trichogramma*.

Our investigations have also shown that nutrition plays an important part in increasing not only the rate of fecundity and longevity of the parasite but also the proportion of female among the entire progeny produced. Proteinous food such as a mixture of honey, sugar, agar and water is most suited to the parasites for higher rate of fecundity as compared to those which starve. Flanders has pointed out that at the higher rate of fecundity a larger number of eggs escape

ertilization. This has not been found true in the case of *Bracon gelechiae* which shows different rates of fecundity under varying conditions of nutrition. This fact may be attributed to the vigour of the parasite fed on nutritive food which is responsible for a greater degree of stimulation of the spermathecal gland.

**74. Bionomics and Biology and rate of reproduction in *Apanteles angaleti* Muesebeck (Vipionidae : Hymenoptera), an Endoparasite of the Pink Boll worm of cotton, *Pectinophora (Platyedra) gossypiella* (Saunders) — (Gelechiidae : Lepidoptera).**

E. S. NARAYANAN and G. A. GANGRADE, New Delhi.

*Apanteles angaleti* Muesebeck is a new species, attacking the pink bollworm of cotton, *Pectinophora (Platyedra) gossypiella* (Saunders). It is a solitary internal parasite and is one of the potential parasites for the control of the pink bollworm of cotton. The biology of the parasite particularly the egg stage and the three larval stadia and the relation of the earliest hatched parasitic larvae to the later hatched larvae have been studied in great detail. The parasite thrusts its eggs inside the body of the freshly hatched larvae which are about 24 hours old. Beyond this age, the preference diminishes almost abruptly. It has been bred in the laboratory on an alternate host, *Corcyra cephalonica* for the first time. The incubation period lasts about a day only and the first instar larva occupies from 10 to 17 days on an average at different temperatures of 31°C, 30°C, 25°C and an average relative humidity of about 70% at all the temperatures. The second instar larval period is comparatively short, occupying about 5 to 10 days on an average at the above temperatures. The second instar larva, when full fed, emerges out of the host body by cutting a hole and immediately enters the third instar stage which is of a very short duration. The characteristic feature of this instar is that it completes the final stage of its development by feeding on the body fluid elsewhere on the host body by plugging the exit hole by means of the last anal segment and then spins a cocoon inside the cocoon of the host, prepared previous to emergence of the parasite pupa. The adults emerge out of the cocoons by cutting a circular hole at one end in about 5 to 6 days on an average at the different temperatures and the humidity mentioned above. The adults mated soon after emergence and laid eggs within the hosts to the extent of 170 eggs. Usually only one egg is deposited in a host but many hosts are superparasitised and the supernumerary eggs or larvae are destroyed by the early hatched larva that has powerful and sickle shaped mandibles. So one larva develops in a host. In addition to the study of biology, some factors such as the effect of darkness on oviposition, the effect of amputated antennae on the behaviour of the parasite and its capacity for oviposition, the effect of restraint on the oviposition response of a female, the discriminative ability of the parasite between the parasitised and the non-parasitised hosts, were also studied in detail. The longevity of the parasite was studied with food in the form of raisin and glucose (10%) at 50%, 70% and 90% R.H. at each of the constant temperatures of 18°C, 25°C, 30°C and 35°C. The longevity, though not significant at other humidities, was found to be slightly higher at 70% R.H. at all temperatures with raisin as food.

**75. Bionomics and Biology of *Chelonus narayani* Sp. Nov. (Hymenoptera : Braconidae), an Egg Larval Parasite of the Gram Caterpillar *Heliothis armigera* (Fabr.).**

E. S. NARAYANAN and K. R. THAKARE, New Delhi.

The Braconid, *Chelonus narayani* sp. nov. has been recorded as a parasite of the gram caterpillar *Heliothis armigera* (Fabr.) and jowar stem borer *Chilo zonellus* Swinh. for the first time in India. It is identified as a new species by Muesebeck,



C. F. W. It is important to observe that this is a potentially beneficial parasite of some of the serious lepidopterous pests like *Heliothis armigera* (*obsoleta*) (Fabr.), and *Chilo zonellus* Swinh. For the first time in India, the bionomics and biology of this parasite have been studied in great detail.

Noble and Clausen have pointed out that *Chelonus* parasites breed readily on Mediterranean flour moth *Ephestia kuehniella* Zeller, and Bradley has described in detail a method for its laboratory rearing on the Mediterranean flour moth. Mass breeding on the alternate host *Corcyra cephalonica* Staint. has been successfully carried out in the parasite laboratory of the Division of Entomology, I.A.R.I., New Delhi for the first time.

Detailed studies in mating, preoviposition period, oviposition, larval development, emergence of parasites from the host, pupation, seasonal distribution etc. have been carried out. The female parasite oviposits inside the host egg, and the newly hatched parasite larva waits for the complete development of its host within the host egg and enters into its body prior to its hatching out. Its further life is passed within the host and the full grown parasite grub emerges out of the host body and pupates and brings about the death of the host. The incubation period of the egg is 10 to 15 hours, larval period 30 to 45 days and pupal period 10 days at an average temperature of 27°C and relative humidity of 75%. The maximum longevity of the adults is 25 days when fed on glucose solution and split raisin. The parasite has been observed in the field in fairly large numbers both during the summer and winter months.

#### 76. Studies on the Immature Stages of the Genus *Bracon* and the Genus *Stenobracon* (Hymenoptera : Braconidae).

E. S. NARAYANAN and K. R. THAKARE, New Delhi.

The immature stages of six different Braconid species such as *Bracon gelechiae* Ashmead, *B. gelechiae* Ashmead sub-species, *B. brevicornis* Wesmead, *B. greeni* Ashmead, *B. chinensis* Szep. and *Stenobracon dcesae* (Cameron), have been studied for the first time in great detail. These studies reveal differences in structures not only in the various stadia of the individual development of a single species but also from the point of view of the study of the comparative morphology of the various species in the same stages of their development.

The mouth-parts, especially the mandibles of all the six species are specific in their characters and differ from each other in the shape of their basal plates, number of comb like teeth and the general outline. Some of the mandibles possess saw like teeth. The facial rods constitute two arches in all the species, and are joined posteriorly by hypomaxillary sclerome. The general set up of these arches is peculiar in each species. The tracheal system, however, in all the species is similar to each other in the basic plan but greatly differs in the mode of ramifications. De Leon in his studies on *Cocloides dendroctoni* Cush. observes that the prothoracic spiracle is the largest and that the spiracular trachea differs in its length in the different segments of the body. The present investigations show that all the spiracles are similar to each other and that the spiracular tracheae are of the same length in all the segments.

The body setae have been studied in great detail and a nomenclature based on the studies of prothoracic setae only by Phillips has been given for the first time for setae occurring in the other regions of the body. Parker's conclusion that the setae on the prothoracic segment are constant in the same species have been confirmed in these studies and have been made use of in the classification of these species and in the preparation of the key.

Besides these studies in the external morphology, a detailed study of the internal morphology has also been carried out especially concerning the differ-

nces in the morphological details of the silk glands and malpighian tubules of the different species.

#### 77. Confirmation of the Number of Larval Instars in the Genus *Bracon* by the Application of Dyar's principle.

E. S. NARAYANAN and K. R. THAKARE, New Delhi.

A large number of workers have critically discussed the value of Dyar's law on growth of caterpillars in Lepidoptera. During the course of the present experiments studies were made whether Dyar's law would hold good in the case of the different species of *Bracon* parasites viz., *Bracon gelechiae* Ashmead, *Bracon gelechiae* Ashmead sub-species, *Bracon brevicornis* Wesmeal. It was found that the head widths of *Bracon gelechiae* Ashmead, *Bracon gelechiae* Ashmead sub-species and *Bracon brevicornis* Wesmeal when measured gave 1.3018, 1.2991 and 1.2851 as their growth factors respectively. Further, by the application of these growth factors calculated head widths were obtained and then calculated head widths were compared against the observed head widths, they showed a close approximation. From this it was concluded that there are five larval instars in each of the three *Bracons* studied.

Use of the reciprocals of Dyar's ratio was tried by Ripley and Calvert but both failed to arrive at any definite conclusion. During the present investigations the use of the reciprocals was not tried because the direct use of Dyar's ratio gave significant results.

The selection of material at random for study as proposed by Taylor has greatly helped in obtaining these significant results. Overlapping of the observations during the successive instars as studied by Glover in *Bracon tachardiae* Cam. could very well be avoided by the use of a high power microscope.

Lastly, the plotting of the head width measurements on graph paper, of all the three species, provided a means for their comparison and was found to be useful in separation of the closely related species developing under one and the same condition of environment.

#### 78. Anatomy of the digestive system of *Poecilocerus pictus* (Fabr.).

P. K. B. MENON, Pilani.

There are several points of interest in the anatomical details of the digestive organs of this grasshopper. The oesophageal musculature is thicker than the musculature of any other region of the alimentary canal. Compared to other orthopterous insects the gizzard is not well developed. The chitinous intima of the crop region is not uniform throughout. The cardiac valve is studied and a type of cardiac press is found. The author thinks that it acts more as a sphincter than as a valve. The peritrophic membrane is present. There is no evidence to show that it is derived from the brush border of the enteric epithelium. On the other hand, there is sufficient proof to show that it takes its origin from near about the cardiac valve region. The histology of the so-called rectal gland has been studied.

The nature of the brush border of the epithelium is discussed. The structures of the hepatic caeca, both anterior and posterior pouches are studied. The lumen of the posterior pouches is filled with disintegrating cells. The epithelium has got a brush border, and the cells are closely packed together.

#### 79. Experiments and Observations on an Indian Dammar Bee *Melipona irridipennis*.

K. K. DIXIT and DORA ILSE, Poona.

Experiments on the Sensory Physiology and Behaviour of *Melipona irridipennis* showed that they could, like *Apis mellifera* and *Apis indica*, distinguish clearly



Blue and Yellow coloured papers and to a lesser extent Green ones from grey papers offered in over twenty shades. The experiments also proved that as in the case with most insects, Red is not a distinct hue for the *Melipona* which confuse it with dark grey shades. It is of special interest that these bees could be trained successfully to an "unbiological" stimulus like "silver". Experiments on the perception of forms in these bees showed that a primitive type of "form perception" does exist.

Results of these experiments further indicate that a system of communication comparable to that of "dancing" in *Apis mellifera* must exist in these bees. A sense of time, as in the case of *Apis mellifera* and the Indian species of *Apis*, has also been shown to exist in *Melipona*. In contradistinction to observations made by von Frisch and Kalmus on *Apis mellifera*, and by ourselves on the Indian species of *Apis*, cluster formation during the test was found to be absent in *Melipona*.

#### 80. Studies on the reproductive organs of *Aulacophora cincta* Feb.

R. S. SAINI, Sagar (M.P.)

The reproductive organs of *Aulacophora cincta* differ from *A. foveicollis* Luc. and *A. atripennis* Feb. in many respects and these differences are incorporated in the present paper.

(1) The fourth segment in the male is greatly swollen but such is not the case in *A. foveicollis* and *A. atripennis*.

(2) The posterior margin of the last (or definitive seventh) sternite in the female is almost rounded except for a slight shallow depression, while in *A. foveicollis* it is divided into two lobes by a deep notch.

(3) The scrotum of *A. cincta* is sharply marked into four follicles but the division is not so sharp in *A. foveicollis* and *A. atripennis*.

(4) The endophallus is a straight tubular structure in *A. cincta* but it is curved in *A. foveicollis* and *A. atripennis*.

(5) The vesica is armed with 4—6 spines in *A. cincta*, while with numerous spines in *A. foveicollis* and *A. atripennis*.

(6) Number of ovarioles in each ovary is 42 in *A. cincta*, while 28 and 29 in *A. foveicollis* and *A. atripennis* respectively.

(7) The median genital chamber is in the form of a wide tube in *A. cincta*, while it is round or oval in *A. foveicollis* and narrow and tubular in *A. atripennis*.

(8) The spermathecal duct is greatly reduced in *A. cincta*, quite long in *A. foveicollis*, and moderately long in *A. atripennis*.

#### 81. Observations on the Post Embryonic Development of *Machaerota* Sp.

A. P. MATHEW, Trivandrum.

The cercopid genus *Machaerota* has several peculiarities. The adults differ from all other cercopids in possessing a disproportionate pronotal spine like the Membracids while the nymphs have the most curious habit of making calcareous tubes in which they live. The successive stages in the life history are traced and the relation of the instars to the tubes in which they live is shown. The tube material is "the spittle" so characteristic of the cercopids but used in a remarkable way. The life cycle is completed in two tubes—the primary tube being a slender narrow tube lodging the tiny early nymphs and the secondary tube secreted by the enlarged nymphs of the advanced stages. Usually these two tubes are found side by side and older observers failing to understand the role of the narrow tube (Primary) suggested that it may be for aeration.

1st instar 8—10 days; 2nd instar—8—10 days (In Primary tube).

3rd instar 6—7 days; 4th instar 15—18 days (In Second tube).

## ENTEROPNEUSTA .

82. Enteropneusta from Madras and the Gulf of Manaar, with a note on the probable course of distribution of *Ptychodera flava* Eschscholtz.

KANDULA PAMPAPATHI RAO, Waltair.

An examination of the literature available on the Enteropneusta from the Gulf of Manaar and the Madras waters was made, with reference to the available collections from these localities. The collections made by the author over a three year period included three genera, each genus being represented by a single species. A systematic account of all the known enteropneusts from the areas under consideration is presented. All the three families of Enteropneusta, namely, Harrimanidae, Spengelidae and Ptychoderidae are represented by one or more species. The genus *Saccoglossus* (Harrimanidae) is represented by two species, *S. bournei* (Menon) and *S. madrasensis* Rao. Of the Fam. Spengelidae, adults of only one species of *Glandiceps*, namely, *G. coramandelicus* Spengel are known from this area. A second species, *G. stiasnyi* Rao was described by Rao (1953) from young worms obtained by rearing tornaria larvae collected from the Madras plankton. Fam. Ptychoderidae is represented by two species of *Glossobalanus* (*G. minutus* and a *Glossobalanus* species closely resembling *G. elongatus* Spengel) and by five varieties of *Ptychodera flava*, namely, var. *krusadiensis*, *pallivausalensis*, *shinglensis*, *coralliformia* and *gigantica*.

From a correlation between the surface currents in the Indian Oceans and the known distribution of *Ptychodera flava*, the routes of dispersal of this species, starting from the Maldive and Laccadive archipelagoes as a centre of distribution, are suggested.

83. Two species of Enteropneusts from off the coast of Madras.

KANDULA PAMPAPATHI RAO, Waltair.

Dredge collections made off the coast of Madras yielded two species of enteropneusts. One was identified as belonging to the Genus *Saccoglossus*. A comparison of the present form with the known species of *Saccoglossus* revealed that the form under consideration was new to science and is hence created into a new species, *Saccoglossus madrasensis*. A definition based on external features and the internal anatomy is given.

The other enteropneust was identified as a species of *Glossobalanus*. In its structure and appearance it was found to resemble very closely a mediterranean species, *G. elongatus* Spengel. If it really is *Glossobalanus elongatus*, then this will be an interesting case of discontinuous distribution.

## FISH AND FISHERIES

84. The inter-relationships between total-length, standard length, body-weight and gonad-weight of *Megalaspis cordyla*.

(KUMARI) G. G. DATAR and D. V. BAL, Bombay.

A study with regard to the relation between total-length, standard-length, body-weight and gonad-weight was carried out by examining about 500 specimens of *Megalaspis cordyla* during the year 1952-53. Graphical methods were used to check the relation between total-length and standard-length and also that between total-length and body-weight and to find out the actual constants involved in the relations. It was then studied with the help of correlation table and analysis of



variance how the body-weight was related with the gonad-weight and the relevant laws were established. In the case of the last named relation all the calculations were carried out separately for the immature and maturing specimens. The partial correlation coefficients between total-length, standard-length, body-weight and gonad-weight have also been determined.

#### 85. The Enzymes of Some Elasmobranchs from Bombay : Amylases.

(Miss) D. S. GHANEKAR, D. V. BAL and (Mrs.) K. SOHONI, Bombay.

The study of amylases of different tissues of *Scoliodon sorrakowah* and *Sphyrna blochii*, shows that, (i) in both the fishes amylolytic activity is maximum in pancreas, minimum in intestine, muscle, heart and brain, intermediate in liver, spleen and kidney and absent in stomach and ampullae of lorenzini, (ii) pancreas and liver of both the fishes contain  $\alpha$ - and  $\beta$ -amylases, kidney amylase is a desmo-form  $\alpha$ -amylase and that of spleen is a lyo-form  $\beta$ -amylase. In case of pancreas desmo-amylase is predominantly of  $\alpha$ -type and Lyo-amylase is of  $\beta$ -type, (iii) the thermostability and acidability of  $\alpha$ -amylase and the thermostability and acidability of  $\beta$ -amylase of *S. sorrakowah* and pig pancreas can be reversed by the presence of  $\text{Ca}^{++}$  in enzyme extract, (iv) Pancreatic lyo-amylase of both the fishes shows the probable presence of proamylase, (v) the mixture of lyo- and desmo-amylases and also desmo-amylase of pancreas of the two fishes are unstable when stored at  $0^{\circ}\text{C}$ ., while the pancreatic lyo-amylase on the other hand is not only stable at  $0^{\circ}\text{C}$ ., but its activity increases on storage and (vi) 41 fold purified amylase was obtained from the pancreas of *S. sorrakowah* and some of its properties studied.

#### 86. The Air-bladder and its Relation with the Auditory Organ of Hilsa tili.

(Miss) P. D. NAYAK, (Miss) M. R. VARDE and D. V. BAL, Bombay.

A detailed account of the air-bladder in *Hilsa tili* with special reference to its relation with membranous labyrinth has been described here. The air-bladder consists of two layers tunica externa and tunica interna. The arterial blood is supplied by coeliaco-mesenteric artery and the venous blood is drained by gonadal vein. The nervous supply is from visceralis.

The exoccipital is excavated into a fusiform bulla, the pro-otic into an anterior-osseous bulla and the pterotic into a posterior-osseous bulla. The anterior-osseous bulla bears a fenestra on the cerebral surface and is divided into an upper and lower compartments by a septum. The recessus utriculus of the membranous labyrinth lodges three macula acusticae which lie near the fenestra of the anterior-osseous bulla. The precoelomic diverticulum from the anterior end of the air-bladder gives anterior air-vesicle into the anterior-osseous bulla and a posterior air-vesicle into the posterior-osseous bulla. The anterior one occupies lower compartment of anterior-osseous bulla.

Neither the utriculus nor any one of the macula acusticae sends a diverticulum to join the anterior air-vesicle.

#### 87. Fisheries of Certain Tropical Fishes in Natural Cold Waters of India.

SUNDER LAL, HORA, Calcutta.

The wide occurrence of the Central American Poeciliid Mosquito-Control fish, *Gambusia* (*Schizophallus*) *holbrookii* Girard, is recorded from lakes and paddy fields of the Kashmir Valley. Though no data regarding its introduction in the Valley are available, the fishermen became aware of its presence in natural waters a couple of years ago and now curiously comment on its live-bearing habit. The

roduction of this fish in the Mysore State is also referred to as it forms a hery there.

The introduction of *Anabas testudineus* (Bloch), *Colisa fasciata* (Bloch), *C. una* (Ham.) and *Ophicephalus striatus* Bloch in the Manipur Valley, Assam, in 30-31 is referred to and it is shown how in 5 or 6 years' time they became minant commercial fishes of the Valley.

Both in the case of *Gambusia* in Kashmir and *Anabus*, *Colisa* and *Ophicephalus* Manipur, the acclimatisation of tropical fish to cold waters, is commented upon and it is suggested that their behaviour under changed climatic conditions should e investigated.

#### 8. On the structure and development of the Weberian apparatus in a Siluroid fish, *Silundia gangetica*.

H. K. MOOKERJEE, D. N. GANGULY and S. K. DAS, Calcutta.

In the present investigation an attempt has been made to find out the exact ature of the different component parts forming the Weberian ossicles of the iluroid, *Silundia gangetica*. Following observations are made on the study of the mbryological history to determine the component parts of the different structures.

(1) The claustrum is cup-shaped, and is attached to the tripus by inter-ssicular ligament. It is a modified neural arch of the first vertebra.

(2) True intercalarium is absent.

(3) The tripus is a thin, flattened structure directed antero-posteriorly. It is ormed by the co-ossification of second and third ribs with part of fibrous tissue resent.

(4) Inter-ossicular ligament is present.

(5) The first vertebra is very small, and is inseparably connected with the econd vertebra.

(6) Perineural tube of Mookerjee, *et al* (1952) is a ring-like structure that sur- rounds the spinal cord. It is a modified occipital arch.

(7) The *ossa suspensoria* are additional processes developed from the basi- ventrals. Each *os suspensorium* joins mid-ventrally to form a kind of arch over the dorsal aorta.

#### 89. On the functional morphology of the organs concerned with intake of food of some teleostean fishes in relation to their feeding habit: Topography of the facial portion and gross anatomy and histology of lips and barbels.

H. K. MOOKERJEE, D. N. GANGULY and B. D. HAJRA, Calcutta.

The structures of the lips and barbels of forty species of common Indian tele- ostean fishes belonging to twenty-two different families are mainly described here to find out their correlation with the feeding habits.

The observations are :—

(a) The fishes examined are classified into three primary groups according to the presence or absence of taste buds, and also to the frequency of the taste buds where they are present. The groups are named as, (i) taste feeders, (ii) taste and sight feeders, (iii) only sight feeders.

(b) Group I, feed on food from mid and bottom regions largely by taste. The lips of the fishes of this group contain several taste papillae. Each taste papilla contains numerous taste buds.

(c) Group II, feed on both surface and bottom food with the aid of vision and taste. They have several taste buds on the lips but the frequency of the taste buds is less than that of the Group I.



(d) Group III, feed mainly with the aid of vision. They possess no taste buds on the lips. They may, however, possess taste buds behind the lips but their lips do not help in selecting their food.

(e) Barbels are either gustatory or gustatory as well as tactile in function.

(f) Barbels of Group I are purely gustatory in function.

(g) Barbels contain no central cartilaginous axis running from the base to the tip as stated by Sato (1937).

(h) A great majority of the Indian fishes are sight feeders.

(i) As regards the preponderance of the sight feeders over the taste feeders, and sight feeders, the present work lends additional support to the earlier contention of Mookerjee, *et al* (1950).

(j) The present study, also, lends additional support to the contention of Mookerjee and Ganguly (1951) regarding the vertical distribution of major carps of India.

(k) The present study justifies and confirms the classification of fishes studied, according to their feeding habits by Mookerjee, *et al* (1950).

(l) So far it is observed from the forty species that the fishes with non-protractile mouth may or may not possess taste buds but the fishes with protractile mouth have no taste buds.

## 90. Origin, Distribution, Phylogeny and Interrelationship of Ophicephalid Fishes (Snakeheads, Murrels of India).

M. CHANDY, Delhi.

The snakeheads or Ophicephalids belong to the class Actinopterygii, subclass Neopterygii, Order Percomorpha, suborder Ophiocephaloidea. Truly speaking it is not a Labyrinthici. The group is characterised by the absence of spines on the dorsal, ventral and anal fins and the possession of specialised accessory respiratory organs of the pharyngeal region.

Ophicephalid fishes are exclusively fresh water fishes of the old world, enjoying a wide distribution from the Amur River in eastern Siberia in the north, through China to India, Burma and Ceylon, Thailand, Indo-China, Malay Archipelago, the islands of East Indies as far as Flores and finally through Afghanistan, Baluchistan and Persia to the tropical Africa.

The probable place of origin is in Southern Asia, perhaps in the region of Yunan in South China where the marshy waters of Siwalik gulf extended during the Pliocene or earlier. There are about 20 or 21 distinct species now classified under one genus. Of these India has 11 species while the islands of the East Indies have 8 or 9 in all and Africa has 3 species, endemic to that continent. A detailed analysis of the distribution of the species sheds light on the zoogeography and inter-relationship of the species.

A comparative study of the external morphology, dentition, number of vertebrae and other morphometric features has revealed the probable trend of evolution of the group.

It is presumed that *Ophicephalus gachua* is the most generalised species. This species or a form very much like it must have been the hypothetical ancestor. The main trends of evolution are as follows:—

(i) The increase in general size of the body, with consequent increase in the number of dorsal and anal rays, the scales of the transverse and longitudinal series. (ii) Also, the lengthening and deepening of the head snout with accompanying changes in the cephalic shields and pores of the lateral-line system; size and position of the eye. (iii) Dentition shows modification and specialisation—the caninoid teeth become localised on maxilla, become fewer in number and larger in size. (iv) The supra-branchial organ for aerial respiration shows increasing complexity from the simple to the more advanced species.

**1. The composition of Hilsa ilisha (Ham.) catch in the Lower Sundarbans area during the winter months.**

H. L. SARKAR, Delhi.

The paper deals with the length-frequency distribution of *Hilsa ilisha* caught on the Sundarbans area. The samples and data were collected from a particular hal (creek) during December-March in two consecutive years, 1947-48 and 1948-49. Together 688 fishes were studied during these periods. Only the length of the fish was noted. The ratio of the sex of fishes could not be determined due to the difficulty of examining the condition of the gonads. Even the external examination by pressing the abdomen of sample of fishes failed to indicate the sex of fish.

The topography of the place of catch has been indicated. The paper also includes a short account of the type of the net used and methods of catch. Moreover the tabulated data of the fishes, exact dates of the catch, percentages of the catch for two years and a histogram have been given.

Attempts have been made to determine the stocks of the fishes from which they came and their rate of growth.

**2. Effluents from the Erode Cauvery Textiles Limited, Bhavani, and their effect on the fisheries of the Cauvery river.**

R. SRINIVASAN and R. GANESAN, Bhavanisagar, Madras State.

The Erode Cauvery Textiles Ltd. at Bhavani, processes handloom cloth (viz. Bleaching, Printing and Finishing) and discharges its effluents into the adjacent Cauvery river. The various processes in the factory and the nature and amount of effluents from each process are described. The effects of the untreated effluents on the chemical quality of the water, the rheoplankton, and the fisheries of the river are discussed. The waste waters were found harmful to fish life for their low pH, high suspended matter and B.O.D. and had to be diluted at least 200 times or treated (as suggested by the King Institute, Guindy) with 20 grains of lime and 10 grains of alum per gallon of effluent and allowed to settle for about 8 hours to render them innocuous. In view of the occasional low flow of water in the river especially during the summer months, the factory authorities were advised to treat the effluents as suggested above and to discharge them in the middle of the river where there is the maximum flow of water.

**93. Amino Acid composition of Marine Fish Proteins.**

R. VENKATARAMAN and S. T. CHARI, Kozhikode.

Applying the paper chromatographic techniques—circular, single and two dimensional runs—the amino-acid composition of the crude proteins of two marine fishes viz. Mackerel (*Rastrelliger kanagurta*) and Sardine (*Sardinella fimbriata*) has been qualitatively evaluated after acid and alkaline hydrolysis. The following amino-acids were common to the two fishes: Phenyl Alanine, Leucine, Isoleucine, Valine, Methionine, Tryptophane, Proline, Alanine, Glutamic acid, Threonine, Glycine, Serine, Aspartic Acid, Arginine and Lysine.

Tyrosine, Histidine and Cystine were also found in the case of the Mackerel fish whereas they were only in traces in the case of the Sardine.

**94. The Bacterial Flora of Shark.**

R. VENKATARAMAN and A. SREENIVASAN, Kozhikode.

The bacterial flora on the surface of elasmobranchs were reported by Wood (1950) to be different from other fishes (Teleosts). This was found to be true of



the sharks caught off Tuticorin. There was a definite enrichment of gram positive bacteria on the surface of freshly caught (live) shark, due to the presence of large numbers of *Bacillus*, *Corynebacterium*, *Micrococcus* and *Sarcina*. There were fewer numbers of *Achromobacter*, *Flavobacterium* and *Vibrio*. One unidentified yeast was also present. There were many pigmented forms, mostly among the Cocci, *Corynebacterium* and *Flavobacterium*. Pink *Bacillus* was also noted here. The *Corynebacteria* were similar to those described by Wood (1950). Two of the were urease positive. Urea fermenters were also detected in enrichment media. Presence of these urea splitting bacteria may be responsible for the early spoilage of sharks. /None of the bacteria produced  $H_2S$  or indole.

#### 95. Spoilage of Commercially Canned Fish.

R. VENKATARAMAN and A. SREENIVASAN, Kozhikode.

Commercially canned mackerel and sardines from a canning factory were examined and found to contain putrefactive anaerobes in the cans showing "swells". The sardine cans were only slightly swollen but the mackerel cans were found to have putrefied, producing a large quantity of foul gases. The spoiled cans of mackerel were found to contain a few millions of anaerobic sporeforming bacteria. They were similar to *Clostridium parasporgenes* and developed stinking smell in protein media like, cooked meat, egg (coagulated), and gelatin. Coagulated egg was completely liquefied in 48 hours as also gelatin. Cooked meat was digested and blackened. Slight indole production was noted. Autoclaving at 15 lbs. (121°C) for 45 minutes in cooked meat medium destroyed them completely. The spoilage may be due to unhygienic plant condition and due to contamination by raw materials. The digested egg white meat and gelatin showed loss of amino-acids.

#### 96. Studies on the Use of Crushed Salt for Fish curing.

R. VENKATARAMAN and A. G. VASAVAN, Kozhikode.

Till recently powdery salt from Tuticorin was being supplied to Fish Curing Yards all along the west coast of Madras State. Average sodium chloride content of the powdery salt consignments never exceeded 90% (on dry basis). The Indian Standards Institution has prescribed 96% sodium chloride, as the minimum required for edible salt. As this is not practicable immediately as far as the fish curing industry is concerned, a very much improved variety of salt called crushed salt, the sodium chloride content of which varies between 92% and 96% was introduced during the year 1953-54 in all the Fish Curing Yards. The fish cured with this salt was found to be definitely superior to the one cured with powdery salt. Laboratory experiments were also conducted. Pomfrets of medium size (9"-12") were cured experimentally. The product obtained was much superior to the fish cured with powdery salt in appearance, texture, flavour and keeping quality.

#### 97. Drying of Fish with Infra-red Lamps.

R. VENKATARAMAN, A. G. VASAVAN and A. SREENIVASAN,  
Kozhikode.

It was thought desirable to see if infra-red lamps could be used for drying fish. Preliminary experiments were done with salted pomfrets (*Stromateus* spp.) It was seen that there was complete drying in just under 6 hours when the temperature of the chamber was 60°C. The moisture content was reduced by

20%, i.e. from 58 to 38. The effect of infra-red heating on bacteria was remarkable. Within the first 45 minutes heating, when the temperature had risen from 30°C to 50°C the bacterial numbers were drastically reduced from 2,470,000 to 42,000 i.e. by 98.3%. The final count after 6 hours was only 1300, which is almost a sterile product. Physically the product tended to become flaky and there was partial cooking also. Further experiments at lower temperatures and with various other fish and prawns are in progress.

It was also noticed that pink colonies of bacteria decreased from 3.7% to 0 at the end of drying, while the white and grey colonies slightly increased from 59.3 to 61.5% and yellow Cocci increased from 29.6 to 33.3%. It is interesting to note that the Cocci, which are usually halophilic are also thermotolerant.

#### 98. Spawning habits of the milk-fish, *Chanos chanos* (Forsk.) in the coastal waters of Madras State, India.

P. I. CHACKO, West Hill.

Basing on field observations over ten years, the author has made the following conclusions. *Chanos* has a main spawning season from March to July and a secondary season from October to November. The spawners congregate in small schools, not exceeding 60, in selected areas along the coast where the depth is less than 80 feet, during dark nights of new-moon periods. This accounts for the difficulty in obtaining breeders. They are 3—5 feet in length and 24—30 pounds in weight. The ripe ovary is 1—2 feet in length and 3 pounds in weight. Ovarian egg is 0.70—0.75 mm. in diameter; and average about 19—20 lakhs in a gravid female. The breeding grounds are near saltwater lakes, backwaters or river-mouths, where there is a slight reduction in salinity. This facilitates the drifting of eggs and early larval stages into the protected backwaters and tidal creeks. Hydrographical factors, particularly salinity, appear to play an important part in the spawning of this fish, and also in the hatching of the eggs and the growth of the larvae. The diameter of fertilised eggs vary from 0.75—8.0 mm. in Vizag and Nellore coasts to 1.1—1.2 mm. in waters around Krusadai Island in the Gulf of Manaar. It is probable that the milk-fish of the different areas are of more than one race. There is a partial coincidence of spawning of *Chanos* with that of *Elops indicus* and *Megalops cyprinoides* though the main season for the latter two species is during the north-east monsoon. In the swarming of the larval stages there is preponderance of *Elops* and *Megalops* in the early part of the season.

#### 99. The 1953-54 bumper fishery of the oil-sardine (*Sardinella longiceps*) of the west coast of Madras State.

P. I. CHACKO, West Hill.

The oil-sardine fishery, which is one of the most important in the economy of the west coast, declined gradually to a disastrous extent from 19,23,593 maunds in 1933-34 to 237 maunds in 1946-47. Since 1950-51 it began to show signs of revival; and in 1953-54, 22,90,890 maunds valued at Rs. 75,98,403 were landed. This is the highest for all years for which statistics are available. During the year the fishery existed in all the twelve months, the peak period being November, December and January, when 9,70,901, 4,80,058 and 3,07,176 maunds were landed. The chief landings were at Madai (1,88,675 mds.) and Madapalli (1,30,815 mds.) in north Malabar Coast, and at Malpe (1,58,895 mds.), Hosdrug (1,41,350 mds.) and Kumbala (1,29,833 mds.) in South Kanara Coast. The concentration of the fish near the shore was so great that many shoals entered estuaries and back-



waters. The fishery commenced in July with spawners 18-20 cm. in size. In September, young ones contributed to the fishery; and during the peak period, November-January, juveniles constituted the catches though few spawners (20-21 cm.) were noted. In May and June, adults (15-17 cm.) with maturing gonads composed the shoals. There are thus definite indications of successful spawning, and of recruitment of zero, one and two years old fish. This augurs well for a fair, if not phenomenal, fishery in 1954-55.

**100. A review of the 1953-54 fishery of the Mackerel, *Rastrelliger kanagurta*, of the west coast of Madras State.**

P. I. CHACKO, West Hill.

In 1953-54, 5,80,038 maunds of mackerel valued Rs. 39,27,500 were landed, this being the fifth lowest figure since 1925-26. The fishery started in July with a landing of 9,452 mds. of fish comprising 10-16 cm. in size and less (80 per cent) and above one year in age (20 per cent). In August 22,301 mds. were landed, the individuals being of 10-19 cm. in size with 18 per cent less and 80 per cent above 1 year and 2 per cent, 2 years in age. In September the landings improved to 17,265 mds. of 15-21 cm. individuals of which 7.5, 51.5 and 41 per cent were 1, 2 and 3 years old. In October the landing was 1,27,852 maunds, size and age composition being unchanged. In November, the fishery was at its peak, with 2,10,177 mds. of juveniles (11-14 cm.) of which 54 per cent were less and 27 per cent more than one year, and 10 per cent 2 years. In December, 1,62,487 mds. were landed, the fish being 20-25 cm. in size and 2 (12 per cent), 3 (64 per cent) and 4 (24 per cent) years in age. There was a set-back in January when 21,674 mds. only were landed; and thereafter the shoals dwindled and finally disappeared in May. During these months, 8,740 mds. of 20-25 cm. size and 3-4 age groups, many of which were spawners, were landed. Few-shoals of baby-mackerels (5-6 cm.) appeared in June. Recruitment of young ones in July, August, November and June into the population, and occurrence of spawners in March and April might result in distinct improvements in the fishery in 1954-55 and succeeding two years.

**101. Hydrobiology and Fisheries of the Corteliar Estuary, Ennur, Near Madras. in 1953-54.**

P. I. CHACKO, West Hill.

Rainfall of 34.73 inches was spread over nine months but mainly in October. Humidity was 94% in May and 59% in December. Atmospheric temperature was 94°F in May and 78°F in November and December. Surface temperature of estuary-water was 92°F in April and May, and 72°F in February. Specific gravity increased to 1.038 in August and decreased to 1.000 in October. The pH ranged from 7.8 in October and November to 9.1 in December. Higher salinity of 39.1-42.5‰ was observed when the estuary had no connection with the sea. Lowest salinity was 0.6‰ in October, when oxygen-content was high (26.8 cc/l). The latter was low (6.6 cc./l) in May. Sedimentation ranged from 1.0 to 7.0 cc. per planktonhaul. Diatoms were common in the first and last quarters. *Nitzschia* was abundant in April, May, June and November; and *Coscinodiscus* in April, May and November. Copepods and their nauplii were common throughout. There was swarming of *Noctiluca* in April and December; and of *Ceratium* in January. Fish eggs and larvae were noted in June, February and March. Bulk of the fish-catches (40-59%) were *Mugil cephalus* and *M. dussumieri*. *Leiognathus fasciatus* and *L. insidiatrix* (1-24%), *Anodontostoma chacunda* (12-25%), *Chanos chanos* (1-8%), *Elops saurus* (1-8%), *Therapon jarbua* and *T. puta* (1-3%), *Thriposocles malabaricus* (1-5%), *Gerres setifer* (1-12%) and prawns (1-10%) were also present throughout the year.

*Troplus suratensis*, *Tylosurus strongylurus*, *Lutjanus lineolatus*, *Sillago sihama* and *Eleutheronema tetradactylum* were scarcely obtained. The average daily landing of a single boat ranged from 19 lbs. in July to 46½ lbs. in February.

**102. Prospects for a pearl fishery off Tuticorin, Gulf of Manaar, in 1955.**

P. I. CHACKO, West Hill.

The irregular cyclic nature of the pearl fisheries of the Gulf of Manaar is well known. Since 1926-28 there was no fishery off the Tirunelveli coast. With the establishment of a marine biological station at Tuticorin in 1947, systematic surveys of the pearl-banks were being made; and a spat-fall was first detected by the end of 1949. The development of this oyster population was watched since then. A detailed inspection of the banks made by the author in March-April 1954 has revealed that the oysters have grown and flourished over a wide area, showing interesting age variations from 0 to 3½ years. Considering the major age-groups, the banks could be divided into two sets. In the first set comprising of the Tholayiram-par, Athombothu-par, Koothadiar-par, Vadaeombothu-par, Saithombothu-par and Pulipundu-par, there is a total population of 3 crores, which is fishable early in 1955. The other group consisting of Nadumalaipiditha-par, Periamalaipiditha-par, Karaikaruwal-par, Velangukaruwal-par and Tiruchendur-poonthottam-par, has a population of younger oysters which might mature for a fishery in 1958 if they survived till then. Arrangements are being made for the pearl fishery in the first set of banks in February-April 1955. Fishing of all types on all the banks has been prohibited by Government notifications.

### MAMMALIA

**103. Histological changes of the thymus of *Loris lydekkerianus* (Cabr.).**

B. A. GULAM AHMAD and M. APPASWAMY RAO, Bangalore.

Lemuroids exhibit many anatomical and developmental features which are considered by a few investigators as primitive and by others as secondary simplifications. Therefore the thymus of embryos, juveniles and adults of *Loris lydekkerianus* weighing from 17 to 345 grams was studied. It is well developed in the foetus and in the young forms and consists of two lobes uniting midventrally and is situated ventral to the pericardium. Each lobe has a convoluted cephalic portion which extends lateral to the trachea up to the thyroid gland. The persistence of such cephalic portions of the thymus in a fully formed embryo (CR length of 30 mm.) and in the juvenile forms is considered as a primitive feature. Each lobe is composed of many lobules separated by inter-lobular connective tissue. In each lobule the medulla is extensive, and is continuous with the other lobules. The Hassall's corpuscles, though large, do not exhibit such characteristic configuration of cell arrangements as in the adult. In the thymus of specimens weighing 77-85 grams the demarcation between cortex and medulla gradually disappears, the capsular wall is thick and the cortical cells, pycnotic. The medulla contains large Hassall's corpuscles exhibiting well-defined concentric arrangement of cells and often the central cells undergo degeneration. It is interesting to note the presence of plasmodial masses and large cystic spaces indicating primitive characters, as such features are commonly found in the reptilian thymus. The thymus of the lactating female is greatly reduced and undergoes involution as described in other mammals. Thus the thymus of *Loris lydekkerianus* shows a few primitive features in addition to its generalised anthropoidian characters. It is, however, difficult to say if the presence of these primitive features is due to



secondary simplification. As these characters occur in the embryonic condition also it will not be erroneous to conclude that these primitive features are primary and not due to secondary simplification.

**104. Reproductive cycle of the male Indian Gerbille, *Tatera indica cuvieri* (Waterhouse).**

M. R. N. PRASAD, Bangalore.

This study of changes in the reproductive organs of the male Indian gerbille is based on 250 males collected in the different months of the year. Earlier, it has been shown (Prasad, 1954) that the young are born from the middle of September to the beginning of March. The activity of the male roughly corresponds with the breeding activity of the female. Activity of the males as determined by the presence of spermatozoa in the testes, epididymes and vas deferens, extends from the middle of July to the end of April. During the months of May, June and early July the reproductive organs are regressed and spermiogenic activity is at its lowest. Animals in these months include those which have previously been mature and are now in a state of quiescence, as well as immature animals brought forth comparatively late in the breeding season. The distribution of the body weights in these months shows that animals of the heavier weight groups of the previous seasons either suffer a heavy mortality or undergo great reduction in body weight. The ranges of the pre- and post-pubertal animals overlap during this period. The testes increase in size as well as in weight from the middle of July and attain the maximum in December and January, and regress greatly in the middle of May and June. The diameter of the seminiferous tubules and the epididymes tubules increases corresponding with the weight and activity of the testes. The activity of the accessory organs of reproduction shows similar correlation with that of the testes. From a study of the cyclic reproductive activity of the male it is seen that the males become sexually active a little earlier than the females and continue their activity for some time after the cessation of activity in the female.

**105. Ecological studies of the Mammals of Rajasthan desert : Distribution.**

DAYA KRISHNA and ISHWAR PRAKASH, Jodhpur.

This paper starts a series of Ecological studies of the mammals found in the desert of Rajasthan. A part of the work on hedgehogs was done under the patronage of the Birla Education Trust and the rest is being done by the aid of U.N.E.S.C.O. under their Arid Zone Research programme. This first paper records the mammals, their classification and their distribution. A rough idea of density of population has also been recorded. The mammals for this study were divided in two categories—1. Vegetation destroyers and 2. Non-vegetation destroyers. Populations of the former are more abundant than that of the latter.

**106. Ecological studies of the mammals of Rajasthan desert. Hedgehogs : Fossorial habits.**

DAYA KRISHNA and ISHWAR PRAKASH, Jodhpur.

Very little is known about the habits of Insectivora and especially of the Indian species. *Hemiechinus auritus collaris* Gray and *Paraechinus micropus micropus* Blyth were collected from North-east of the Rajasthan and were kept in large cages in the laboratory. They ceased their fossorial activities in the cages. They were then left in a closed courtyard (semi-captivity) and their digging and other habits were observed.

These Insectivores spend most of their life under the grounds and inhabit small mounds dug by themselves. These sub-terranean tunnels are straight pouches in earth, length of the tunnel:—12" to 24"; diameter of the opening of the tunnel:—2.5" to 4"; diameter of the inner blind end of the female burrow in the breeding seasons:—4.5" to 7"; depth of the burrow:—5" to 8". There is no 'run'. Only one individual lives in a tunnel. In the breeding season the female widens the inner end of the tunnel to accommodate the youngsters. During the process of digging its burrow, the hedgehogs loosen the earth by the lateral strokes of the forelimbs which are armed with broad spade-like claws and shove earth by the hind feet.

In winter (November to March) hedgehogs bury themselves to hibernate in their burrows. They are generally observed to close the entrance but leave small passage for respiration.

It is concluded that *H. auritus collaris* is more fond of tunnels than *P. micropus* which can live under dense branches of a bush.

The paper also includes a discussion on the systematic position of these animals and their distribution.

#### 7. Ecological studies of the mammals of Rajasthan desert. Hedgehogs : Feeding habits.

DAYA KRISHNA and ISHWAR PRAKASH, Jodhpur.

It is generally believed that hedgehogs destroy vegetables and crops, especially the modified roots and stems. This work was planned to study their preference for food. Vegetable as well as animal food was offered to them in captivity and semi-captivity. Their food in nature was studied by examining the contents of their alimentary canal just after they were caught. These contents always showed the presence of remains of insects, certain bones and other animal tissues; plant tissue was never observed. In addition to insects, in captivity they took raw meat and frogs and in semi-captivity they took milk also. They were also observed to feed over their companions in all conditions. They need very small quantity of water for their healthy existence.

#### 8. Ecological Studies of the mammals of Rajasthan desert. Hedgehogs : Rolling.

DAYA KRISHNA and ISHWAR PRAKASH, Jodhpur.

Hedgehogs roll up in an impregnable ball of spines whenever any danger approaches. For this rolling, powerful muscles are developed in them. This paper deals with the muscles, and their blood and nerve supply. On the dorsal side the superficial layer is of *musculus orbicularis* which bears spines. The muscle is about 5 mm. thick and controls the movement of spines. Just below this there are two bands of *longitudinal muscles* on either side of the vertebral column. They originate from the inter-nasal suture. In the middle of the body each of the bands divides into two, and enters the sacral vertebrae. And beneath these bands of longitudinal muscle, there is *muscle latissimus* which originates from the proximal region of humerus and inserts in the ribs and in membranous poneurosis. There are certain transverse muscles in the tail region which might be of help in reducing its width. They originate from the third and fourth caudal vertebrae and are inserted in the membrane of the tail.

#### 9. Ecological Studies of mammals of Rajasthan desert. Gerbilles.

DAYA KRISHNA and ISHWAR PRAKASH, Jodhpur.

Two varieties are found in desert area, *Meriones hurrianae* Jerdon (diurnal) and *Tatera indica* Hardwicke (nocturnal). The environments and conditions (loose



sand, paucity of water, extreme temperature and almost no rain fall and very little vegetation) are described which influence the animal life. Their revised systematic positions have also been discussed in the paper.

The *M. hurrianae* usually are found away from man but *T. indica* can be found near habitations. Gerbilles inhabit burrows (long tunnels) dug by themselves in hard open barren land. Tunnels have no fixed plan. The digging is done with forelimbs and shoving with hind limbs. Relation of gerbilles with the soil is also established in the paper and comparison of digging of both the species is observed.

They have been observed to change their habits to protect themselves from the heat of the desert during summer. The diurnal gerbilles shift their tunnels under the small bushes (*capparis*, *euphorbia*, *juliflora* etc.) and they become slightly nocturnal, rather divide their activities in two rhythms; three hours in the early morning and three hours after dusk.

Different methods of population count were tried but counting of the opening of the tunnels proved to be the most accurate and convenient.

Feeding habits of these were studied in nature, semi-captivity and captivity and a wide variety of food was tried. Their preference of food has also been investigated. In nature they have never been observed to drink water at all. So it is suggested that they conserve water from their solid food.

The paper also deals with their distribution and population.

#### 110. Sex-cycle in *Taphozous longimanus* (Hardwicke) Microchiroptera.

A. GOPALAKRISHNA, Pilani.

A majority of bats whose reproductive cycles have been studied show that they breed only once a year in a sharply defined breeding season. The bats living in temperate and cold climates copulate in autumn, and the sperms hibernate in the genital tract of the female throughout winter and fertilise the ova in the next spring. In the case of bats that live in tropics copulation takes place in "spring" and is immediately followed by fertilisation and pregnancy. In certain bats like *Lyroderma lyra lyra* (Gopalakrishna, 1950) copulation and fertilisation take place in autumn. In all these cases the species breeds only once a year and brings forth one litter per year.

*Taphozous longimanus* differs from all other bats so far studied with the possible exception of *Desmodus rotundus* (Wimsatt, 1953) in having no sharply defined breeding season. It breeds throughout the year and brings forth more than one litter per year and in quick succession. This is evidenced by the following facts:—(i) pregnant females were collected in all the months of the year, (ii) specimens collected during any one month showed that different females were at different stages of sexual activity ranging from immature non-parous condition to fully lactating condition, (iii) several females which were in lactation and carried a young in the breast showed on dissection that pregnancy had again started in one of the uterine horns, (iv) there is an alternation of the uterine horn in successive pregnancies as is evidenced by the study of the histology of the ovaries and the uteri. Hence post-partum oestrus appears to be a common phenomenon in this species.

There is an extraordinary type of sex ratio—the males being in very small numbers whereas there is a great predominance of females.

## MARINE BIOLOGY

**A Preliminary Note on the Marine Organisms Injurious to Submerged Timber in the Bombay Harbour.**

V. C. PALEKAR and D. V. BAL, Bombay.

A coastal survey of the Bombay Harbour was carried out during the course of the year 1953-1954, and the deteriorating remnants of wooden structures such as, fenders, ladders, country-crafts etc. were inspected to locate the damage from marine wood borers. Certain species of Molluscan borers affecting submerged timber were chiefly those of *Teredo*, *Bankia* and *Martesia*. The Molluscan borers were conspicuous by their absence. The observations made during the survey seem to indicate that the marine wood borers are to some extent limited to certain localities in their distribution. The Shipworms, namely *Teredo* and *Bankia* were vigorously active at the Sewree timber pond, while the Piddocks, *Martesia* sp. at Pir Pau and Mud Island. These were generally found to occur on submerged timber structures though occasionally they were also noted on the same structure. A note has also been made on the fouling organisms which take shelter in the timber and live in the burrows formed by the borers.

**Marine Denitrifying Bacteria—with a Description of New Species.**

A. SREENIVASAN and R. VENKATARAMAN, Kozhikode.

The surface off-shore sea water off Calicut contained denitrifying bacteria in small quantities, as also the sea water off Tuticorin. Of the 97 plate cultures obtained from off-shore sea water, as many as 13 were denitrifiers, liberating gaseous nitrogen from nitrates. Of these 9 were identical, non-flourescent, polar flagellated, hitherto not described in literature. They have been named as *Pseudomonas inodenitrificans* n. sp. The other denitrifiers were, *Ps. denitrificans* and *aeruginosa*. The three others appear to be new species, but are not named.

By using 1%  $\text{KNO}_3$  it was found, that the denitrification was not complete after one month but nitrites were present. Accumulation of nitrites was considered to be toxic by Karlsen (1938) but excepting the *Ps. denitrificans* all the cultures denitrified 0.2%  $\text{NaNO}_2$ , which disappeared in 48 hours. In the presence of 0.5%  $\text{NaNO}_2$  *Ps. denitrificans* did not at all grow and the *Pseudomonas* of group F. grew but did not denitrify. All the other cultures denitrified in this medium. Nitrites were still present but there was also gas formation. Some of these groups decompose  $\text{KNO}_3$  to gaseous nitrogen even anaerobically, while some do not grow anaerobically, in the presence of  $\text{KNO}_3$ .

With lactate as hydrogen donor, denitrification occurred in five groups. Citrate was used as hydrogen donor by five groups. Two of the citrate users did not utilise lactate. With glucose, only one culture was able to denitrify  $\text{KNO}_3$  in the absence of other sources of nitrogen.

**Effect of Sewage Effluents and the Coliforms on Sea water.**

R. VENKATARAMAN and A. SREENIVASAN, Kozhikode.

The town sewage and the lavatory effluents of Harvey Mills are let into the sea at Tuticorin. The fate of coliform bacteria thus thrown into the sea was studied in September 1953 and again in March 1954. The 'M P N' of coliforms exceeded 1,600,000 per 100 c.c. about 10 yards down the site of outflow. But there was a very rapid disappearance of these, more than 99.5% disappearing in  $\frac{1}{2}$  a mile from shore. At  $1\frac{1}{2}$  miles from shore the 'M P N' of coliforms were only 4 per 100 ml. and at 5 miles it was just 4 (doubtful presumptive). At a distance



of 8 miles opposite the effluent, no coliforms were detectable. The total count showed a similar trend of decrease.

#### 114. Utilisation of Various Nitrogenous Compounds by certain *Pseudomonas* Cultures from Marine Environments.

R. VENKATARAMAN and A. SREENIVASAN, Kozhikode.

The amino-acids and other nitrogenous compounds utilised by seven cultures of *Pseudomonas* in the presence of sodium citrate or glucose are recorded. They were divided into seven groups on the basis of morphological and cultural characteristics and physiological properties.

Excepting the *Pseudomonas* belonging to Group A (*Ps. marinodenitrificans* sp.), and Group B, all the others utilised a large number of amino-acids as the sole source of nitrogen. Glutamic acid, arginine and choline were the compounds used by all the groups of *Pseudomonas*, but better in the presence of citrate than in the presence of glucose. Tryptophane, tyrosine, phenylalanine and asparagine were the next best sources of nitrogen for these bacteria, followed by cystine, glycine and urea. Valine appeared to be a poor source of nitrogen and culture showed very scanty growth with this amino-acid. Only one culture utilised potassium nitrate as the sole nitrogen source, in the presence of glucose. The maximum number of nitrogenous compounds utilised by any one of these groups was eleven out of thirteen, and the minimum was five. Some of these cultures derived the energy required for denitrification from these amino-acids and other nitrogen compounds. Contrary to the findings of Ostroff and Henry (1939) that tyrosine was toxic, our cultures not only utilised it for growth, but also for denitrification. Likewise contrary to their finding that guanidine was not available for the growth of any of their marine bacteria, we found that arginine, which has a guanidine nucleus was not only available to all the cultures tested but that out of seven groups denitrified in its presence.

The true 'marine' bacteria i.e. those requiring sea water for growth were the least reactive and utilised only five out of 13 compounds in the presence of citrate and seven, in the presence of glucose. Only glutamic acid was able to act as a 'hydrogen donor' for denitrification by this group.

#### 115. Bacteriology of Off-shore Marine Environments (Pearl Banks) off Tuticorin

R. VENKATARAMAN and A. SREENIVASAN, Kozhikode.

The number of bacteria in off-shore sea water is almost constant, being about a few score. The number growing on sea water medium was greater than that growing on fresh water media, indicating an enriched 'marine' flora.

No coliforms were detected in sea water or sand near the 'Paars'. But the chanks brought from these 'Paars' contained coliforms, which is probably adventitious due to handling.

Denitrifying bacteria were present in 1 c.c. of sea water and in 1 gram of sand. Sulphate reducers were detected in the bottom sand about 8 miles off-shore. Algin digesters and chitin digesters were found in surface water and sand. Ulcer fermenters were absent in sea water but were present in bottom sand. Cellulose fermenters were absent in water, but sand and the chanks contained cellulose digesting bacteria. Agar digesting bacteria occurred in remarkably large numbers in the bottom sand and in fewer numbers in sea water. Many of these were profusely pigmented and liquefy agar in 24 to 48 hours. They are considered to be new species. About 7 to 10% of colonies from sand and 2-3% from sea water were agar liquefiers. They are thin, long, flexuous pleomorphic rods and one was a *Pseudomonas*. Two of the algin digesters were peritrichous rods resembling

*acterium alginovorum*, Waksman. None of the bacteria so far studied, utilised enol (*Mycoplana* spp.) in contrast to the findings of Wood and Shewan. The following genera were recorded: *Pseudomonas* (non-pigmented), *Achromobacter*, *cillus*, *Corynebacterium*, *Micrococcus*, *Sarcina*, *Bacterium* and *Chromobacterium*. majority were amylase positive but very few were saccharolytic. Nitrate reducers and gelatin liquefiers were common. Indole and  $H_2S$  producers were so present.

#### 6. Preliminary observations on the zonation of the fauna and flora of the intertidal rocks at Waltair.

G. BALAKRISHNAMURTHY and KANDULA PAMPAPATHI RAO,  
Waltair.

A critical review of the literature on the subject of marine intertidal zonation presented which highlights the fact that no similar studies of any systematic nature were hitherto made on the Indian coastline.

A preliminary survey of the fauna and flora of the rocks on the Waltair coast revealed a well defined pattern of zonation. Five zones were recognised by us between the extreme high water of spring tides and the zero tide (*chart datum*). They are tentatively named as (a) the littorinid, (b) littorine-*Cellana*, (c) *Cellana-alanus*, (d) balanoid and (e) *Caularpa* from extreme high water downwards towards the sea.

A descriptive account of the fauna and flora of each, with indications of the relative abundance of the common plant and animal species found therein, is given.

#### 17. Biology of Some Marine Wood Boring Organisms of Visakhapatnam Harbour.

P. N. GANAPATI and R. NAGABHUSHANAM, Waltair.

Although considerable amount of work has been done on the biology of the marine wood boring organisms in the European, American and Australian waters very little has been done in tropical waters especially in the Indian Seas. Observations and collections of *Teredo* and *Martesia* were made for a period of one year (1952-53) at four stations inside the Visakhapatnam harbour.

*Teredo navalis* was observed to be breeding throughout the year though the intensity of breeding season extends for a period of five months from July to November. The males are smaller in size than the females and fewer in number. The primary gonad is bisexual and a change of sex from male to female is observed when the animal is about 20 to 30 mm. in length. Natural enemies of shipworms have also been dealt with.

*Martesia striata* breeds throughout the year. Observations on the gut contents of *Martesia* may indicate that it is purely a plankton feeder and bores into the wood for the sake of shelter alone just like *Xylophaga dorsalis*. However, final decision as to the capacity of *Martesia* to digest wood will have to await the results of biochemical tests of the gut contents. A change of sex was noticed in *Martesia striata* for the first time, the young forms being males, and the sex-change from male to female occurring when the animal is between 15 to 25 mm. in length.

A survey of the Hydrographical conditions of Visakhapatnam harbour waters was made for a period of five months (February '53 to June '53) which revealed two important facts. The wood borers are practically absent at the fourth station due to the (1) high pollution and consequently low oxygen content in the water and accumulation of hydrogen sulfide and (2) the heavy growth of barnacles and sea weeds on the jetties may form a physical barrier for the entrance of the



borers. A comparison of the activity of molluscan borers at Cochin and Vizag harbours has been made.

**118. Preliminary Observations on the Hydrography and Inshore Plankton in the Bay of Bengal off Kakinada Coast.**

V. S. R. MURTHY, Waltair.

The paper embodies the results of a preliminary investigation on the Salinity, Temperature and Phytoplankton production in the inshore waters off the Kakinada coast between the latitudes  $16^{\circ} 20.0' N.$  to  $17^{\circ} 29.0' N.$  and longitudes  $82^{\circ} 11.1' E.$  to  $83^{\circ} 27.1' E.$  The material for the investigation was collected from 61 stations on board the Minesweepers of the Indian Navy, during the Oceanographic cruises Nos. 3, 10, 13 and 17 conducted by the Andhra University, from November 1952 to April 1953, under the guidance of Prof. E. C. La Fond, Visiting Professor of Oceanography at this University. The stations represent profile of the coast of about 30 miles off shore.

The variations in the Salinity, Temperature and Phytoplankton production are found to be influenced by the prevailing currents in the Bay. As in the Visakhapatnam coast here also two peaks in the phytoplankton production could be made out, one in November and the other in April. The available data for temperature indicate that the upwelling taking place in the Visakhapatnam coast, does not seem to occur on this coast and consequently the temperature of the surface water increases during the month of April. The different regions in the area under review were found to vary in their salinity and temperature conditions and also in the production of the phytoplankton.

**119. Conservation of the marine fauna and flora of Krusadai Island, Gulf of Manaar.**

P. I. CHACKO, West Hill.

Krusadai Island in the Gulf of Manaar is well-known as the marine biologists' paradise in India. The flora and fauna of the area are the richest known in the country. The living and dead coral reefs are easily accessible during the low tides. A brief account of the biota of the various parts of the area is given to facilitate observations by the students visiting the island. Special mention may be made of the Galaxea reef and lagoon, Balanoglossus area, sponge bay, bush point, pier and boat anchorage, pearl oyster park, Porites bay, watchman's bay, milk-fish swamp and the mangrove area, each with its own plant and animal communities that are of interest. Consequent to wasteful collection of material by visitors during the last three decades, there is a marked depletion in the flora and fauna. Hence the area is declared a sanctuary since September 1953. The students are given facilities to observe and study the marine life under natural conditions and also in the aquarium. It is hoped that all Biologists in the country will co-operate with the authorities to make the conservation a success. The reefs and mud flats of the neighbouring islands will also get enriched from the sanctuary. It may be mentioned here that this is the first instance of declaring a sanctuary for marine flora and fauna in our country though there are rules and regulations prohibiting fishing in selected areas and encroaching structures of port and harbour authorities.

**120. Hydrography and plankton of the inshore sea opposite the marine biological station, West Hill, Malabar Coast, in 1953-54.**

P. I. CHACKO, West Hill.

The data recorded were from the 3 fathom line of the sea from April 1953 to March 1954. Surface temperature varied from  $25.9^{\circ}C$  in July to  $29.8^{\circ}C$  in April.

specific gravity from 1.015 in July to 1.030 in June; and pH from 7.9 to 8.6. Salinity was 18.08 ‰ in August and 35.95 ‰ in May; carbonates 15.5 ‰ in August and 18.9 ‰ in January; dissolved oxygen 1.6 cc/l in May and August and 3.9 cc/l in January; phosphates 2.9 mg/m<sup>3</sup> in January and 18.2 mg/m<sup>3</sup> in March; and silicates 2.8 mg/m<sup>3</sup> in January and 17.4 mg/m<sup>3</sup> in March. Rainfall was 81.90 inches spread over all the months except December. Phytoplankton predominated during major part of the year, the peak being 94% in August and 91% in January. *Coscinodiscus* had two maxima in May and August. *Biddulphia* was common in May, December and February. *Chaetoceras* occurred in large numbers in most of the months. *Asterionella* was abundant in January. *Rhizolenia* was in swarm stage in May, February and September. *Nitzschia* was fairly present in March and September. *Thalassiothrix* swarmed in April and December; and *Trichodesmium* in August, February and March. Copepods were the common zooplanktons; and they were abundant in October, December, February and March. *Noctiluca* was common in September. *Ceratium* was present in August, September, December and April; and *Peridinium* in May, November and February. The fishery during the year was a feature by unprecedented landings of the oil-sardine, *Sardinella longiceps*.

### MISCELLANEOUS

#### 121. Some Interesting Features of the Aquatic Fauna of the Kashmir Valley.

SUDER LAL, HORA, Calcutta.

The observations embodied in this paper are based on two faunistic surveys of the Kashmir Valley carried out by the Zoological Survey of India during May-July 1921 and May-June 1954. The material collected during the last survey is still under investigation in the laboratories of the Zoological Survey but opportunity is taken to make some preliminary general observations here.

The Kashmir Valley originated as a syncline of the Middle Himalayas during the Miocene and about 5 lakh years ago (2nd Interglacial Period) it formed the big Karewa Lake. During a comparatively recent period, when the Pir Panjal Range was uplifted and the Karewas formed, the Valley assumed its present structure and cut a drainage, the present-day Jhelum River, on the western side. The Valley has a general elevation of 6000 feet and is surrounded on all sides by lofty, snow-clad mountains. Climate is temperate during summer but bitterly cold during winter. Spring-fed streams are comparatively warmer than the snow-fed streams. Vegetation is luxuriant in lakes and other stagnant or slow-flowing waters.

Under these geographical and ecological factors, the fauna shows the following peculiarities :—

1. Isolation with a high degree of endemism of species.
2. Preponderance of Central Asiatic element in the fauna.
3. Smaller number of species but larger populations of each species.

The various ecological associations are defined and the characteristic animals of each are enumerated. The problems of evolution, adaptation and speciation of the fauna are discussed.

#### 122. Further experiments on the control of aquatic vegetation with '2.4-D'.

R. SRINIVASAN and P. I. CHACKO, Madras.

Experiments on the control of water hyacinth (*Eichornia crassipes* Solms) in the Fort Moat at Palghat and in the Ootacamund Lake by means of Fernoxone



which contains the sodium salt of 2,4-D are described. The chemical is found useful in killing the water plant; and has to be sprayed at the rate of 2.5 pounds per acre. A second spraying has to be given to cover the plants missed during the first one. The present cost of the treatment works out to Rs. 27/8 per acre.

Laboratory and field experiments showed that in a concentration of 2 p.p.m. Fernoxone is also able to kill submerged plants like *Hydrilla verticillata*, *Najas najas* and *Potamogeton indicus* in about 20 days at a cost of about Rs. 30 per acre per one foot depth. In the above dose Fernoxone is found to be harmless to fish life and freshwater biota.

### 123. Alcoholic Clove Oil Method for simultaneous Dehydration and Clearing.

N. L. SHAH, Poona.

Dehydration, at present, is accomplished by lengthy and complicated drop method or by using closely graded series of alcohol of increasing strength. In this paper a short and convenient method for dehydrating and clearing sections, smears and squashes is suggested. It is rapid and simple to be practised by a beginner. 30% clove oil in absolute alcohol is used for the purpose. Excess of water, after staining etc., is drained and shaken off. Alcoholic clove oil is poured on the slide which comes in contact with water and becomes turbid. This turbid or cloudy mixture drains off the slide and is replaced by clove oil alcohol which continues to drop from a dropping bottle. Ultimately the cloudy appearance on the slide disappears and the section or smear looks transparent. This means that the slide is cleared at the same time. Then the slide is immediately plunged in xylene. If the relative humidity of the atmosphere is fairly high, the percentage of clove oil in absolute alcohol is increased and 20% clove oil in xylene is used as an intermediate steps. This method has got further advantages. The alcoholic clove oil can differentiate stains which are rapidly extracted by higher grades of alcohol. The differentiation is slow and thus convenient. Some acid dyes, dissolved in alcoholic clove oil, can be used for simultaneous counterstaining along with dehydration and clearing processes. No visible shrinkages or artifacts were noticed in 5000 preparations made so far. The reason is discussed in the paper in details.

## SECTION OF ANTHROPOLOGY AND ARCHAEOLOGY.

*President*:—DR. B. K. CHATTERJEE, M.Sc. (Cal.), D.Sc., State, (Paris)

### *Abstracts*

#### PHYSICAL

##### **Brachycephaly in India.**

S. S. SARKAR, USHA DEKA and K. K. AGARWAL, Calcutta.

In this paper all available data on the cephalic indices of samples of 50 or more individuals, have been utilised to find out the different centres of brachycephaly in India.

Three populations, each having about 75-80% of brachycephaly, appeared to be the three primary centres of this character. They are: (i) Kakar of N.W.F.P. (76.8 3.97%); (ii) Limbus of Nepal (82.0 5.43%); (iii) Chakmas of Chittagong Hill Tracts (77.0 4.41%). Three zones can therefore, be differentiated which have been called A, B and C for the sake of brevity. Zone A comprises, N.W.F.P., Punjab, Rajputana and its southern extensions. The brachycephaly of Gujrat, Maharastra, etc. appears to be a southward extension of Zone A, as the percentage of brachycephaly is much lower than that found in the main centre. Zone B comprises the Himalayan foothills. Zone C comprises the Chittagong Hill Tracts, Bengal and Assam. The rest of the data has been included in the group 'others'.

In Zones A and C the frequencies of brachycephaly have been found to thin out gradually from the centre. Zone B appears to be rather confined in nature.

The brachycephaly of Zone A probably has its origin in the Pamirs and the adjacent regions while that of zone B is probably Mongoloid. The brachycephaly of Zone C does not appear to be related to that of Zone B and since the northern and the western regions of this zone are areas of high dolichocephaly, it appears that brachycephaly of Zone C has its origin in South East Asia. Among the Menangkabau Malays it has been found to occur not only in high percentages of 74.5 but also in the very high cephalic indices above 85 (22.8%). The authors suggest tentatively that this brachycephaly may have some influence in the make up of that of East India.

##### **2. Heights and Weights of West Bengal School Boys.**

MANISH CHAKRAVARTTI, Calcutta.

1,821 School boys between the ages 7-22 from Khardaha, 24-Parganahs (West Bengal) were weighed and measured.

The mean heights of the different age groups 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21 and 22 years were 110.22 cm., 117.76 cm., 122.81 cm., 128.85 cm., 135.07 cm., 138.48 cm., 147.12 cm., 152.98 cm., 158.66 cm., 162.45 cm., 163.30 cm., 164.86 cm., 165.19 cm., 165.03 cm., 166.41 cm., and 167.45 cm. respectively; the means for weights are 37.02 lb., 41.57 lb., 47.00 lb., 51.78 lb., 57.95 lb., 63.43 lb., 74.81 lb., 84.29 lb., 94.25 lb., 100.30 lb., 102.71 lb., 109.34 lb., 110.53 lb., 115.66 lb., 115.57 lb., and 120.44 lb. for the above age groups respectively.

A comparative study has been made with the available data on the South Indian School boys from Coonoor, Mettupalayam and Calicut.



### 3. A Study of Height and Weight of Bengali Girls.

TARAK CHANDRA RAY CHAUDHURI, Calcutta.

In the present paper an attempt has been made to study the height and weight of 129 Bengali School-going girls. The same girl has been measured in successive years at about the same time. The period covered is between three to six years and thirteen age groups ranging from seven to nineteen years have been included. The average height varies from 46.0 inches in age group 7 to a maximum of 59.2 inches in age group 15. The average weights in the groups vary from 40.5 lbs. in age group 7 to 97.4 lbs. in age group 17. The present series has also been compared with a series of Eskimo girls and another of American girls of Dutch descent and it has been found that in the general trend the Bengali series fits well with the other two series, although the Bengali girls are shorter and lighter than the White and taller and lighter than the Eskimo girls.

### 4. A study of Manual Digital formula among the Bengalee and three South-Indian Tribes.

S. R. DAS, Calcutta.

Frequencies of the three types of digital formulae,  $2>4$ ,  $2=4$  and  $2<4$  which have also been termed as human, primitive and simian formulae respectively have been studied among 239 Bengalee, 166 Paniyan, 84 Bet-Kurumban and 35 Adian. The Bengalee sample was taken from Calcutta and the other populations were studied in the Wynaad taluk of the district of Malabar, Madras.

Symmetry in the character has been observed in 61% of Bengalee males, 75% of Bengalee females; about 61% in Paniyan men, 59% in Paniyan women; 69% in Kurumban men and 56% in Kurumban women, and 43% in Adian men.

The following are the frequencies per cent of the human formula :

Bengalee —53.8 (men), 68.8 (women);  
 Paniyan —44.3 (men), 33.3 (women);  
 Kurumban—48.3 (men), 48.0 (women) and  
 Adian —31.4 (men).

Indications of sex-difference and ethnic difference in respect of this character have been found.

### 5. Distribution of ABO, MN Blood Groups and the ABH Secretor Factors among the Tribes of Central and Northern Travancore.

SACHIN ROY, Calcutta.

The materials on which the present paper is based, was collected during the months of December 1953 to March 1954 among the tribes of Central and Northern Travancore. 591 Malids (Vethuvans 64, Muthuvans 140, Ulladans 245, Mala-Aryans 78, and Mannans 64) were examined for ABO blood groups and Secretor factor. For MN blood types 167 persons (Vethuvans 64, and Ulladans 103) were tested. Predominance of group O seems to be typical in South Travancore and is probably a characteristic of the older racial layers. Northwards, A is gaining while O decreases. Among all the tribes belonging to the Malid group the incidence of M is strikingly high and the secretor factor relatively very frequent.

### 6. Studies in the vital capacity of Nocte Naga of Tirap Frontier Division (N.E.F.A.).

P. N. SEN GUPTA, Calcutta.

The vital capacity of 140 adult male Nocte Naga was estimated with the help of a wet type spirometer along with the physical measurements of standing height,

ting height and weight in 1954. Body surface area (Du Bois method) and mid-upper arm circumference, an index of nutrition, were found out in each case. Correlation between vital capacity and other physical measurements shows that 144 subjects of standing height between 150 to 164 cm. have vital capacity of 2.79 to 3.23 litres; 120 subjects of stem length 78.87 cm. have vital capacity of 2.79 to 3.18 litres; 118 subjects of weight between 20 to 39 Kilos have vital capacity of 2.78-3.17 litres and 104 subjects of body surface area between 1.4 to 1.59 sq.m. have vital capacity between 2.71 to 3.14 litres. Correlation curves show that the standing height and weight are more significantly correlated with vital capacity than the sitting height. Coefficient of variation of vital capacity is 15.19%, of weight is 10.00% and of other measurements is between 2.05 to 4.53%. Correlation coefficient is highest between vital capacity and standing height and this is followed by weight, sitting height and surface area. The results have been compared with the average Indian, Chinese, Japanese, English and American standards.

## PREHISTORY : ARCHAEOLOGY

### 7. Some Pre-historic finds in Orissa.

NABENDU DATTA-MAJUMDER, Calcutta.

In the years 1951-1952 while working as Collector of the district of Sundargarh, Orissa, I happened to discover six neolithic implements, a group of four caves known as *Usha-Kuti* containing some paintings, carvings and inscriptions, and also a number of neolithic sites containing numerous flint fragments bearing clear marks of chipping. These neolithic sites and implements have been found in the valleys of the two rivers, Ib and Brahmani. The Usha-Kuti Caves are situated on a hill range in the northwestern corner of the district bordering on Madhya Pradesh. Local legends connect these caves with the epic heroes Rāma, Lakshmana and Sita. The locality of the caves is even now regarded as a part of the ancient *Dandakaranya* (or the Great Forest Belt of Central India).

Circumstances leading to the discovery of these pre-historic finds will be indicated and their description given in this paper. Photographs of the cave paintings and the neolithic implements will also be demonstrated. The evidences already collected clearly show that the district of Sundargarh (consisting of the two ex-states of Gangpur and Bonai) is an important neolithic area. The Archaeological Survey of India should, without delay, depute some competent archaeologist, properly to explore not only the sites already discovered by me, but also a number of other caves about which I collected information but which I could not visit on account of my transfer to another district.

### 8. "A New Post-Harappan Ceramic Ware in Saurashtra".

K. M. SRIVASTAVA, Baroda.

The hiatus between the end of the Harappa culture and the beginning of the historic era has been an outstanding problem to Indian Archaeologists. To bridge the gulf, sites which besides the relics of the historic period in the top levels may also yield remains of Harappa culture at the bottom were required. As a result of the recent excavations at Mota Machiala and Rangpur in Saurashtra, considerable headway has been made towards bridging the gulf. At Mota Machiala with a gap below the Red Polished Ware (a ceramic industry of 1st to 4th century A.D.), a lustrous red ware was brought to light. Subsequently at Rangpur two cultural periods were distinguished with a transition in between. The lower one belongs to



Chalcolithic period having affinities with Harappa culture whereas the upper one represents the same lustrous red ware as discovered at Mota Machiala. While the Harappa culture was dying a natural death in the transition period at Rangpur a new folk who are the authors of this typical lustrous red ware came and settled down there and also initiated occupation at Mota Machiala. This new folk with their lustrous red ware are the successors of Harappans in Saurashtra.

#### 9. Typological Parallelism between *Stellenbosch* (South Africa) and Mayurbhanj (India) Tools.

PRATAP CHANDRA DUTTA, Calcutta.

Techno-typologically, the Lower Palaeolithic hand-axes and cleavers of Mayurbhanj (from the Laterites), India and those of the *Stellenbosch* of South Africa show similar features. In both the Mayurbhanj and *Stellenbosch* industries, the typical tools are the normal peariform and ovate form of the hand-axe and the normal type of the cleaver. The peariform type of hand-axe is somewhat crude and the technique employed is *Abbevillian*. The ovate, a development of the peariform, shows *Acheulean* technique. The 'S'-twist is found in the peariform and ovate types in both the industries. The technique employed for making the normal cleaver type in both the industries is also strikingly similar.

Besides the normal techniques, the so-called *Vaal* or *Pneil* technique which is characteristic of the *Stellenbosch* is also observed in the Mayurbhanj industry. The tool prepared by this technique produces a cross-section in the form of a scalene triangle. The under surface is a single flake scar, while the upper is flaked normally. The thick edge is freely trimmed oblique to both surfaces. A further modification of this technique gives a parallelogramic cross-section, in which the two flake surfaces are parallel to each other and the two edges are boldly trimmed back. Out of 176 specimens of hand-axe and cleaver of Mayurbhanj examined, 60 specimens reveal the *Vaal* technique.

### SOCIAL ANTHROPOLOGY

#### 10. Some Ailments and their Remedies among the Hill Soras (Savaras) of Orissa.

ASUTOSH BHATTACHARYYA, Calcutta.

The Sora, commonly identified with the Savara, mentioned extensively in the Indian classical literature, have concentrated settlements in the Ganjam and Koraput districts of Orissa. The group of this people which live above the hills in the Gunupur Taluq of Koraput district is more conservative and has been able to retain its tribal characteristics to a greater degree than the people living on the plains in the Ganjam district. The natural causes of disease are unknown to the members of this group, therefore they try to satisfy supernatural spirits by offerings and sacrifices made through the women exorcists known as Kuran Bais. The author gives here a first hand account of the various modes of exorcism practised by this tribe as remedies of different diseases. The economic aspect of this practice has also been fully dealt with.

#### 11. A Short Note on the Savaras of Tamruk (Midnapur).

PRABODH KUMAR BHOWMICK, Calcutta.

The Savaras of Orissa are agriculturist while the Savaras of Midnapur are non-agriculturist. The Savaras of Midnapur are considered as an educationally backward class in West Bengal. They live in the easternmost part of the district of Midnapur

ere the local peasantry practise plough cultivation. Amidst the agriculturist folk : Savaras live on 'Snake charming' and the displaying of the same. Women folk e on begging from door to door. Sometimes the male folk spear the birds by ans of a telescopic spear, the shaft of which consists of seven or five bamboo ces. They assert themselves as the descendants of Jara Savara who killed rd Shrikrishna in the 'Dwapara' Age. There are also another two groups of varas living in the same district. The Lodhas—an ex-criminal tribe of West Bengal o assert themselves as the Savaras. The writer carefully described the social, omic and religious conditions of the people in this paper. It is very important have a comparative idea about the different savaras.

## 2. Need of Research in Tribal Welfare.

B. K. ROY BURMAN.

There has been basic change in the concept and methodology of welfare. Rather an philanthropic action it is looked upon as the task of developing scientifically ganised civilization. So content of welfare must be developed with reference to bjective reality, and methodology should be such as to be able to ultimately stimulate e leadership of the tribals themselves. Thorough research therefore is essential r the purpose. Further it must be continuous, for awareness of social situation ough research will by itself create new social strivings and resultant new social tuations, which again will require adjustments in approach to the problem.

## 3. Social Groupings among the Khasi of Assam.

BHABANANDA MUKHERJEE, Calcutta.

The Khasis are not only matrilineal in descent but also matrilocal and neolocal residence. Of the clans (*kur*) and subclan (*ka-k'poh*)—subclans are definitely ncestral. The family is the smallest social group and the clan is the largest and n between the two functions the sub-clan. Functionally the sub-clan and the family lay more important role than the clan which regulates marriage. Each social group s related to the other by means of consanguinity. The function of the sub-clan is ocio-religious. Economic inter-dependence due to closeness of consanguinity is ore among the *shi-k'poh* than among the *shi-kur* and the maintenance of social elations with the kins of clan and sub-clan is the function of the family.

## 14. Bitlaha.

SACHCHIDANANDA, Ranchi.

Among the Santals the extreme social punishment is the '*Billaha*'. Sentence of *Billaha* is pronounced for such serious crimes as family or clan incest or sexual relations with a non-Santal. When the panchayat of the village decides on the necessity for a *Billaha*, news is sent all round the neighbourhood and on the appointed day people gather in hundreds and thousands. The crowd forms a procession and goes to the offender's house singing obscene songs which ridicule the guilty party. The crowd then enters the house and desecrates it by urinating in the interior. The guilt of the couple is thus publicly acclaimed before the entire population and they become the object of public ridicule—and shame. The *Billaha* follows the sentence of formal excommunication by the panchayat; it is the social expression of the extreme disapproval of the community as a whole, it necessitates the active collaboration of great many people, and the enormity of the crime committed is brought home to the guilty parties, as no other measure could do. If the culprits relent, they may be readmitted to the tribal community by the process known as *Jom-jati*.



By effective propaganda and tactful handling the administration has been able to prevent *Bitlaha* from taking place or if it takes place to see that it occurs without least disturbance to village life.

#### 15. A Note on Domestic Painting of Bengal—'Alpana'.

S. R. DAS, Delhi.

In India art is essentially ritual and ceremonial. It is in this art that we have the best reflection of man's mind and thought. This art is neither personal nor aristocratic. It is rather impersonal and democratic, giving an expression of the ideals and feelings of the entire community. Such community ideals and feelings are best expressed in domestic folk ritual and ceremonial paintings of different parts of India. These paintings are drawn on the ground, walls or floors of the house, both inside and outside, on the courtyard, wooden seats, etc. on all socio-religious occasions. They are considered to be very auspicious. They are also believed to contain magical elements. In all cases such paintings are invariably the works of women. These domestic ritual paintings are called differently in different parts of India. In Bengal this domestic painting is known by the common name of *ālpanā*. In this paper an attempt has been made to refer to some literary sources as to the character, technique and purpose of this domestic ritual or ceremonial painting of Bengal called *Alpanā*.

#### 16. Family structure and Laws of Residence, Succession and Inheritance among the Urali of Travancore.

BHABANANDA MUKHERJEE, Calcutta.

The Uralis use the Tamil word *kuttumbam* for a biological family of parents and unmarried children. Investigation into 150 urali families reveals that there are 758 individuals and the average size of the family is 5.05. Of 150 families, there are 138 elementary families and 12 joint or extended. Of these again 130 are monogamous and 20 are polygamous families. Although residence is patrilocal it takes the form of avunculocal at times. The *Marumakkathayam* system which envisages succession and inheritance by sister's sons, has completely been replaced by the *Makkathayam* one (from father to son) today.

#### 17. The Birjias of Palamau.

ASUTOSH BHATTACHARYYA, Calcutta.

- Though extensive ethnological investigations have been carried out over the Chota Nagpur Division of Bihar, yet a small nomadic jungle-tribe known as the Birjia has escaped notice of almost all the workers in this field. It is a small bilingual tribe, speaking its own Austric mother-tongue as well as a southern dialect of Bhojpuriya. Its population is limited to about three thousand people and the area inhabited by it is covered by the most dense forest of Chota Nagpur. As a result of reservation of forest this nomadic jungle-tribe has been confronted with a problem difficult for solution. An attempt has been made in this paper to give an account of the socio-economic condition of this people based on personal observation of the author.

#### 18. Attitude of U.P. Village Women on Purdah and Divorce.

U. GUHA, Calcutta.

This study is a part of the Socio-psychological survey of the eleven villages of Jaunpur district, U.P. 152 Hindu and Muslim women were interviewed regarding

their attitude on purdah and divorce. Most of the women are illiterate. Strict purdah is observed by the Muslim and the Upper caste women viz. the Brahmin, the Chatri and the Kayastha. The rest of the women are free and earn their own living. From this study several inferences can be drawn : (a) the consensus is that the purdah system protects women's honour, (b) the introduction of divorce is much more vehemently opposed than the removal of purdah, (c) there seems to be a deeper significance for the rejection of the privileges. The innate impulses to escape from freedom comes into play. To face the unfamiliar, the unknown give rise to panic and consequent anxiety, (d) the village India of today is not yet ready to accept the new, the untried. In order to facilitate the true acceptance of the inevitable march of time, the action programme should verily begin at the village level.

### 9. Lodha Village Organisation.

PRABODH KUMAR BHOWMICK, Calcutta.

The Lodhas are found to live in the jungle tracts of West Midnapur. They were considered as the criminal tribe in West Bengal before the revocation of the Criminal Tribes' Act. Their traditional occupation is the collection of jungle products. Their tribal organisation as revealed by the writer appears to be based on democratic principles. They have their chiefs or Mukhias and other village officials or their Socio-Political and intra-village relationships. These officials are seen to hold respectable position in the society and got special duties and privileges. Though some of the members inherit their ancestral dignity yet they are seen subject to dismissal for their misconduct and incompetency. During marriage ceremonies or other festivals the headman's consent is sought with special formality of honour. Besides the council members they have Deheri or village priest to deal with the matter of spiritual affairs. They have some trained magicians or "Gunin's to counteract the activities of the evil spirit. The following matters have been seen to be dealt with in their local body of administration and justice :—

- (i) Raising subscription for the village festivities.
- (ii) Realisation and disbursement of the money.
- (iii) Management of the Puja affairs.
- (iv) Cases of adultery.
- (v) Keeping a woman as concubine in presence of a wife.
- (vi) Extra-marital intimacy.
- (vii) Violation of social taboo or communal rules.

Punishment in the form of penalty :—

- (i) Fine according to the financial condition of the offender.
- (ii) Communal Feast.
- (iii) Ostracism.

### 10. An anthropological investigation among the Refugees of Bengal.

M. N. BASU, Calcutta.

The genealogical method along personal observation was employed for the investigation of 400 refugee families of different areas of Bengal, consisting of 2001 individuals. An analysis of the data with some suggestions are discussed in this paper.

### 1. Family Structure of the Kanikkar and the Urali of Travancore.

M. K. NAG, Calcutta.

Data were collected by the author in 1952-53 from 220 families of the Kanikkar and 188 families of the Uralis. Quantitative analysis has been made of the size



and form of the families. The pattern of relationship existing among the members of the families has been discussed in detail. Data have been compared also with the all-India sample collected during 1951 Census. It has been observed that there are certain differences which are very interesting from sociological point of view.

The average family-size of the Uralis is 5.39 which is significantly higher than that (4.25) of the Kanikkar. The bigger size of the Urali families is mainly due to higher fertility of the Urali women and to the higher frequency of polygynous and extended families among them. The proportion of families in which father and married son are living together is higher among the Uralis and the proportion of families in which father-in-law and son-in-law are living together is higher among the Kanikkar. Wife's relatives are present in higher proportion among the Kanikkar of more secluded areas and the Uralis than among the more aculturated Kanikkar. There are 19 polygynous families in the Urali sample and only 3 such in the Kanikkar sample. The system of marriage by exchange of sisters is mainly responsible for higher proportion of polygynous families among the Uralis. The system is not so much in vogue at present but its effect in moulding the existing structure of the Urali families cannot be ignored.

## **22. The Birth and Pregnancy Rites among the Oraons.**

GAUTAMSANKAR RAY, NIREN CHOUDHURI and ARATI SARKAR, Calcutta.

In this paper the authors have described the birth and pregnancy rites of the Oraons. The facts are based upon case-histories collected during their field-work, in the month of January 1953, among the Oraons of Chaha village, under the police station Gumla in the district of Ranchi, Bihar State. In the conclusion the authors have compared the facts collected by them with those of the late S. C. Roy as given in his book, 'Oraon Religion and Customs' written about 25 years ago and have pointed out the significant differences.

## SECTION OF MEDICAL AND VETERINARY SCIENCES

*President* :—PROF. SUSHIL KUMAR BASU, M.Sc., D.P.H.,  
M.B., D.T.M., Ph.D.

### *Abstracts*

#### A. MEDICAL SECTION

##### 1. A Study of Epiphysial Union in Long Bones of Bengalee Adolescents.

S. K. BASU, P. R. DEB and AMITAVA BASU, Calcutta.

This is a continuation of the preliminary study of the Epiphysial Union in Bengalee Girls by S. K. Basu and Sudhir Basu in 1938 and on Bengalee Boys by S. K. Basu, G. S. Chatterjee and Santosh Basu in 1941. The study is of special value because the question of age and economic status of each subject has been established beyond doubt. As in the previous studies, this one presents a hallmark of accuracy and can therefore be counted upon as a standard for reference in text books and in medicolegal matters. The age of epiphysial fusion in Bengalee adolescents differs somewhat from that given in similar individuals of non-Indian origin. The work of previous investigators in India, suffers from one or other deficiency. The study, however, needs to be elaborated on a larger number of Bengalee individuals and the State should come forward to its support. Similar studies on a large scale may also be taken up on the indigenous population of other States of India. The attention of the Central Government is specially drawn to the importance of such studies.

##### 2. The assessment of the type and size of Indian Female Pelvis.

SUBODH MITRA and S. K. BASU, Calcutta.

In this investigation only nulliparous and primigravidae were taken up for assessment by X'ray pelvimetry. Using Thom's classification, the distribution has been found as follows :—Dolichopellic 25·7 per cent, Mesatopellic 49·3 per cent, Brachypellic 23·0 per cent and Platypellic 2 per cent. The maximum and minimum Anteroposterior diameters (in c.m.) of the inlet were found to be 12·88 and 9·17 in Dolichopellic, 12·88 and 9·55 in Mesatipellic, 11·35 and 9·15 in Brachypellic and 10·0 and 9·6 in Platypellic types.

##### 3. A study of the weights of some viscera from 2000 necropsies in Calcutta.

S. K. BASU, B. N. MUKHERJEE, S. K. RAY and AMITAVA BASU, Calcutta.

The weight of viscera of persons of either sex belonging to Hindu (Bengalee and non-Bengalee), Moslem and Christian communities of India has been recorded from birth to 100 years of age. The study is compiled from data collected from necropsies carried over a period of 7 years mainly at Nilratan Sircar Medical College Police morgue. Comparison has been made of the figures arrived in this study with previously available ones. The study also points to the relevance of the so-called ethnic divisions between upper and lower castes and indigenous population of West Bengal as compared with that of other States.



The study is a preliminary one and is expected to be carried further into a larger number of cases. It is unfortunate that in these necropses figures for the stature and weight of the individuals have not been usually available. This would have thrown interesting side light on the development of the body and its organs paripassu with the economic status of the individual, and might perhaps have reflected on the general economic level in a particular period.

#### 4. Wilms Tumour.

BHABANI CHARAN GHOSE, Burdwan.

A case of Wilms tumour has been examined and investigated the results of which are noted below :—

Pyelography report—Rt. kidney is markedly enlarged Rt. renal pelvis and Calices are irregularly filled and deformed. Lt. kidney is normally functioning. The findings suggest neoplasm of Rt. kidney. Urine examination shows abnormality. Blood picture shows Polymorpho-nuclear leucocytosis. Blood urea—26 mgr/100 c.c. of blood. N.P.N.=21 mgr/100 c.c. of blood. P/R=160/60/minute. T=103.5 F. Macroscopic appearance of the mass—The kidney substance is pressed on one side of the tumour of 4"×3"×1½" dimensions. Cut surface shows uniform greyish appearance throughout rather soft in consistency.

*Comment :* According to the concept of tumour causation, arising out of studies of occupational and experimental carcinogenesis, most of the tumours of adult appear after prolonged exposure of the tissues to extrinsic carcinogenic agents, this cannot hold ground in cases of such embryonic tumours. The causes must lie in the disturbed embryonic chemistry during actual organogenesis from tissues which are still immature. The factors responsible for this disturbance, cannot be carcinogens, but something related to nutrition and maturation of embryonic tissues.

#### 5. Primary Hepatic Carcinoma.

BHABANI CHARAN GHOSH and G. CHAKRABORTY, Burdwan.

Primary carcinoma of the liver is a very rare disease in this country, although it is said to be the commonest malignant tumour in the Bantu race of Africa, in whom cirrhosis of liver is almost universal and invariable accompaniment of this carcinoma. Primary carcinoma of liver may be classified in either of two types. (A) Hepatoma or liver cell carcinoma and (B) Cholangioma or bile duct type adenocarcinoma—but a few tumours show both types of structure. Two cases of hepatoma and one case of cholangioma have been discussed.

Hepatoma may show varied type of differentiation, some resembling liver cells, other showing anaplasia, pleomorphism and multinucleated giant cells. Cholangiomas resemble the extrahepatic bile duct adenocarcinoma.

Metastasis often occurs in the liver itself by invasion of PORTAL branch veins. Rarely distant blood borne metastases occur in the lungs or bones. Metastases to pancreas, kidney, mediastinal and retroperitoneal lymph nodes have been noted in the Mass. General Hospital Case No. 32201.

#### 6. Radiation Therapy in Cancer of the Cervix—A New Technique.

SUBODH MITRA, Calcutta.

Since 1926, cancer of the cervix cases have been treated at the Chittaranjan Seva Sadan and later at the Chittaranjan Cancer Hospital with radium and deep x-ray therapy. Limitations and hazards of this treatment experienced. A new

technique with radio-active cobalt and million-volt x'ray therapy has been evolved to ensure more effective approach to the cancerous tumour. The new technique is particularly suitable for thick corpulent patients where ordinary deep x'ray therapy will be of little use without radiation hazards.

#### **8. Evaluation of 5-year End-results in Cancer of the Cervix treated by radiation and operation.**

SUBODH MITRA, Calcutta.

Two parallel series of cancer of the cervix were treated separately by radiation and operation in order to evaluate 5-year cure rate. In spite of meticulous care, all the treated cases could not be traced. These lost-sight-of cases have been considered dead and not taken into account amongst the salvaged cases. The 5-year cure rate with radiation therapy has been found to be 30.1 per cent against 44.2 per cent treated by the author's technique of operation.

#### **9. A New Approach to the Extended Radical Vaginal Hysterectomy and Extraperitoneal Pelvic Lymph-Adenectomy for Cancer of the Cervix.**

SUBODH MITRA, Calcutta.

Surgical treatment in cancer of the cervix reintroduced.

A happy augury would be the emergence of an integrated technique where surgery and radiotherapy will be utilised equally liberally depending on the merits of individual cases.

Author's modification of radical vaginal hysterectomy by supplementing extraperitoneal pelvic lymphadenectomy in a two-stage operation was justified by the presence of cancer-positive glands in 25.4 per cent of the 63 cases operated.

Author's new approach to the extended radical vaginal hysterectomy by combining extraperitoneal lymphadenectomy, extraperitoneal ligation of ovarian and uterine vessels and extraperitoneal resection of parametria along with radical vaginal hysterectomy was a more radical operation. It satisfied all the conditions essential for radical surgery in cancer of the cervix.

#### **9. The Seasonal Effect on the Incidence of Eclampsia.**

SUBODH MITRA, Calcutta.

From an extensive analysis of Calcutta materials it has been found that a significant correlation coefficient is obtainable between the incidence of eclampsia and Maximum Temperature, Relative Humidity with 3 months' lag, and Rainfall with 3 months' lag. But no such relationship is obtained from Minimum Temperature, Range of Temperature, Current Humidity and Rainfall. As an association elicited from correlation analysis could well be fortuitous the need for further evidence to substantiate the plausibility of the association noted above seemed necessary. The data from Madras and Bombay were therefore analysed. In spite of fair amount of similarity in meteorological conditions of these two places with Calcutta, no marked seasonal variation could be found in Madras and Bombay. The absence of a significant correlation coefficient both in Madras and Bombay and their marked difference with the high positive correlation obtained in Calcutta, leads one to the conclusion that the high correlation with lag humidity observed with Calcutta data was only fortuitous. The need for further evidence to substantiate the findings recorded for Calcutta seems necessary before accepting such association as genuine, much less causal.



# 10. Therapeutic Control of the Chief Alimentary Symptoms of Cholera. A Preliminary Study.

HEMENDRA NATH CHATTERJEE, Calcutta.

1. Vomiting, a major symptom of Cholera, occurring in 40% of cases in the Cholera Ward, Chittaranjan Hospital, Calcutta, during the greater part of the 1953 epidemic (1st February to 1st July), could be completely controlled by the oral administration of "Avomine" tablet containing promethazine base and 8-chlorotheophylline.

2. Diarrhoea could be substantially controlled by the oral administration of the strained juice of the leaf of "Pathorchur" (*Coleus Aromaticus*), a common aromatic shrub of Bengal.

No untoward effect was observed on any physiological system by the oral administration of the above leaf juice.

3. In a preliminary series of 200 carefully observed cases treated with the leaf juice, diarrhoea was checked in 40% of cases in 24 hours, in 74% of cases in 48 hours and in 92.5% in 72 hours.

In 40 control cases, diarrhoea was found to have been checked by itself in 5% of cases in 24 hours; in 12.5% of cases in 48 hours; in 74% of cases in 48 hours; in 92.5% per cent in 72 hours.

4. The mortality rate was 8.5% (17 cases out of 200) amongst the leaf-juice treated case; 20% (8 cases out of 40) amongst the control cases; and 19.7% (215 cases out of 1093) among the total cases admitted.

5. The oral administration of the leaf juice was followed up by a daily stool culture directly from the stools collected by means of a boiled rectal catheter and inoculated within fifteen minutes in three different culture plates.

It was noticed that rough colonies of the Cholera *Vibrio* appeared comparatively early, viz. the second culture done after 24 hours of leaf juice administration. The proportion of the rough colonies to the smooth ones continued to go up on the successive days, so that, on the fifth or sixth culture, the smooth colonies were scanty or nil.

In 36 control cases, smooth colonies were preponderating up to the 12th culture.

In vitro, the leaf juice could not convert the smooth type of vibrio into the rough type.

6. The oral administration of leaf juice, however, could not make the stools of the treated cases vibrio-negative, as rough colonies were observed upto the seventeenth day of observation.

This is in a somewhat marked contrast to the results obtained by various workers from the therapeutic administration of 'broad spectrum' antibiotics; the latter have been reported to have rendered the stools vibrio-free, although they could not produce clinical improvement of cholera.

7. The therapeutic control of vomiting by Avomine and of diarrhoea by the juice of *Coleus Aromaticus* enabled the patients with mild or moderately severe symptoms and with blood-specific gravity of 1064 or below to tide over to convalescence without intravenous or parenteral transfusions. These comprised 17% of the cases.

# 11. A Further Study of Alimentary Symptoms of Cholera.

HEMENDRANATH CHATTERJEE, K. K. CHATTERJI, P. R. CHAKRAVARTY  
and R. BANERJEE, Calcutta.

1. Hiccup in cholera is a distressing sign occurring in the later stages of the disease and could be controlled in 9 out of 11 cases by the oral administration of hexamethonium bromide. The fall in systolic blood pressure was within the safety range.

2. Paralytic ileus is a dangerous sign and seems to be amenable to a substantial control by combination of pantothenic acid and prostigmine after terpentine tapes.

3. A blue or black coloured tongue indicates an extremely dangerous condition. Severity of symptoms, high mortality rate and an associated *entamoeba histolytica* infection were some of the features of these cases. Oral terramycin of the bowel infection and transfusion of human plasma for the treatment of the severe dehydration and shock seem to be able to cure these cases.

4. Other different changes that may be seen in the tongue of cholera patients are also described, including the tongue appearances seen usually in the deficiency conditions which might have pre-existed as well as in superimposed infection.

5. Roles of liver and gall-bladder are discussed, as also the pathogenesis of re-water stools. The incidence of gall-bladder symptoms during convalescence greatly reduced in cases whose diarrhoea had been controlled by *Coleus Aromaticus*.

6. Other bowel symptoms like prolongation of diarrhoea and other gastrointestinal symptoms are described. Some of these were relieved by the raw juice of common Indian herb, *Euphorbia pilulifera*. In two cases a chronic dyspepsia is relieved by cholera vaccine.

## 2. A Study of Cholera Stools and the Associated Clinical Features.

HEMENDRA NATH CHATTERJEE, DEB KUMAR BASU and

PRIYA RANJAN CHAKRAVARTY, Calcutta.

1. Some features of the culture-positive stools of 357 cholera cases are given, including physical appearance, reaction and microscopic picture. It would be found that some cases do not conform to the text book character.

2. Concomitant infections with the intestinal protozoa and helminths were so studied in the above group as well as in 719 cases with clinical symptoms of cholera.

3. One of the important causes of the severity of symptoms was the co-existing infection from *entamoeba histolytica*. Many of these patients showed a peculiar blue tongue. Seven cases of this type were symptomatically cured by terramycin along with human plasma transfusions.

4. *Trichomonas intestinalis* appeared to be associated with prolongation of diarrhoea. Stovarsol relieved a few cases.

5. Two cholera cases with associated *Balantidium coli* infection are mentioned, with symptomatic relief from *Coleus Aromaticus* therapy.

6. Presence of *Ascaris Lumbricoides* infection also seemed to be associated with toxic symptoms and prolongation of diarrhoea in some cases.

7. The association of the dysentery group of bacteria with cholera vibrios were found in four cases, all of these showing the *Shigella Flexneri*. Three of these showed the usual symptomatology and were cured, while the fourth one was a very severe case with a fatal termination.

8. Presence of blood in the stools of cholera patients indicate the severity of the disease. This was greatly controlled in a small number of 5 cases by the juice of an Indian herb, *Euphorbia Pilulifera* along with that of another plant *Coleus Aromaticus* which can check diarrhoea.

9. The possible role of some of the parasitic and other infections along with the presence of cholera vibrio in the production of sporadic cases of cholera is discussed.



### 13. A Study of Pyrexia and some febrile and other Inflammatory Complications of Cholera.

H. N. CHATTERJEE, K. K. CHATTERJEE, R. K. SAHA, R. BANERJEE,  
D. K. GHOSH and H. GHOSH, Calcutta.

Some of the febrile sequelae and complications of Cholera might lead to a fatal result although the patient had survived the severe initial stage. The following preparations have appeared to give very helpful results in our hands :—

Associated condition		Drug used
(1) Hyperpyrexia	... ..	Cryogenine.
(2) Pulmonary Oedema	... ..	Priscol.
(3) Broncho-Pneumonia and Lobar Pneumonia	... ..	Terramycin. Terramycin.
(4) Malaria	... ..	Modern anti-malarials and Quinine.
(5) Parotitis	... ..	Terramycin
(6) Herpes Labialis	... ..	Terramycin, Pitressin, Ergometrine Tartarate.

(7) Other inflammatory infections ... Penicillin & Streptomycin.

2. Three cases of late "Anterior Tibial Syndrome" are discussed. The condition resulted as a sequela of transfusion into the leg veins.

### 14. Milk in Treatment of Malaria.

N. K. ROY and A. N. BOSE, Calcutta.

Absolute milk diet or addition of milk as a separate item in the usual diet renders our laboratory mice and rats resistant to *P. berghei* blood induced infection. But to get the maximum effect milk diet is to be resumed a pretty long time before infection. Adoption of milk diet after appearance of parasites in the peripheral blood does not produce satisfactory results. This observation and the fact that replacement of the usual diet breaks the check in the growth of parasites, restrict its use as a suppressive or curative. It may safely be said that milk diet can never be a substitute for anti-malarial drug but may help the drug action by weakening the parasites which when exposed to the action of an anti-malarial drug can no longer offer effective resistance. The effect of milk diet however is of immense scientific interest as regards the study of nutritional requirements of malarial parasite within their animal hosts.

### 15. Effect of Newer Antimalarials on the Morphology of Human Malaria Parasites

H. N. RAY and B. N. DUTTA, Calcutta.

The morphological changes in the human malaria Parasites (*P. vivax* and *P. falciparum*) as well as their disappearance rate from the peripheral circulation in the malaria patients after treatment with therapeutic dosage of newer antimalarials—such as chloroquine, primaquine and daraprim was studied. The various changes in the chromatin, cytoplasm and pigment of the different stages of the malaria parasites have been observed.

### 16. Incidence of Urticaria in Filariasis.

K. C. SAHU, Cuttack.

The allergic nature of many clinical manifestations of filariasis, a common disease in Orissa, is becoming more widely recognised, the adult filariae, micro-

ariae or both being responsible. Among these, the incidence of urticaria in filariasis is common, this being hardly realised. This undoubted form of Urticaria, which is associated with a filarial attack, is of a transient nature, often occurring at regular intervals. They are more probably the result of previous local sensitisation by migrating filariae.

For the last three years investigations, for finding out microfilariae in the lymphatic gland puncture, long before microfilariae begin to appear in the blood; the peripheral blood by thick blood method when it appears there or by the direct method of eosinophilia when its other causes are removed; the personal history taking of the patients playing important part in the correct diagnosis, were carried out on 110 patients suffering from urticaria in the out-patient including the patients referred from filarial clinic and in-patients departments of skin diseases of S. C. B. Medical College Hospital, Cuttack and private patients.

The incidence of Urticaria in Filariasis is 22.7% (25 out of 110 cases), highest among its different incidences in different diseases and circumstances: ingestion of food stuffs 17.3%; bites of mosquitoes and bed bugs 3.6%; injection of foreign serum 2.7%; syphilis 0.9%; bhalla 0.9%; ingestion of drugs 6.4%, inhalation of materials 1.8%; auto-intoxication 10.9%; amoebiasis 8.2%; round-worm infection 3.6%; hook worm infection 1.8%; Diabetes mellitus 0.9%; nervousness and emotion 5.5%; and functional 2.7%.

## 7. Our First and Foremost Approach to the Prophylaxis of Leprosy in India.

G. PANJA, Calcutta.

Leprosy starts as a rule by an initial localised skin lesion. Knowledge about such an initial lesion is entirely lacking in most people however educated they might be and even amongst some medical men. A careful study of a large number of cases shows that the disease is neglected for 1-3 months in 23%, about 6 months in 21%, 12 months in 17%, 2 years in 23%, 5 years in 13%, 10 years in 3% and over 10 years in 3% of cases. Highest incidence of onset of the disease is between 20 to 40 years when outdoor life, manual labour, adventures and association are commonly met with but dirty habits are less frequent. A hypopigmented patch is the commonest form of initial lesion though a single lepromatous nodule has also been seen rarely. If such a lesion is diagnosed early, the disease is easily amenable to treatment and further progress and propagation are stopped.

Our first and foremost duty in the prevention of leprosy should therefore be intensive educative propaganda by giving cinematographic lessons to the school teachers and the taught and the public, by radio talks, by organising travelling medical units for lecture and exhibition of models, charts, etc. by pageant show in streets of towns and by making leprosy as a compulsory subject for qualifying degree for practice of medicine.

## 18. Tricophytin Test for Diagnosis of Ringworms.

G. PANJA, Calcutta.

Intradermal injection of Tricophytin, manufactured by Farbwerke Hoechst of Germany was carried out in several dilutions on test as well as control cases. The test was found markedly positive in both the groups of cases, falsifying thereby the value of the test. No curative value was also obtained. Both urticarial and tuberculin-type of reaction were obtained.



19. Clinical Observations on the Use of Calciferol (Vitamin D<sub>2</sub>) in Psoriasis.

K. C. SAHU, Cuttack.

In Dermatology the treatment of Psoriasis the aetiology of which is not known with certainty, is still a problem, so interesting and so thankless. Therapy with Calciferol, (Vitamin D<sub>2</sub>)—Ostelein forte injection, advanced by the author, in 110 cases, is very encouraging and gives very good result.

For the last five years the author has tried Calciferol injection on all these carefully observed cases of Psoriasis. In 75 cases, chronic and generalised, resulted in almost complete disappearance of the eruption, in 5 cases there was a mild relapse within 2-4 months which responded well to local treatment with Cignolin ointment with or without Calciferol injections. Improvement but with slower progress was noted in 20 cases, no response in 4 cases of Psoriasis of nails. Six cases defaulted. No patient showed any sign of intolerance. The drug exhibits its therapeutic efficiency in all types of Psoriasis, immaterial whether it is flexural, extensor or Psoriasis arthropathica but very rarely on Psoriasis of nails.

On the whole the drug has excellent results, is well tolerated and the effect produced is lasting.

## 20. Clinical Evaluation of Certain Antibiotics in the Treatment of Diphtheria.

J. C. BANERJEA and A. SEN, Calcutta.

155 cases of diphtheria were treated in four groups with A.D.S. alone, A.D.S. and Penicillin, A.D.S., Penicillin and Streptomycin; A.D.S. and Terramycin. Of these 155 cases, 12 could not be evaluated. The rest were evaluated on the following criteria :—

1. Disappearance of patch.
2. Incidence of Pulmonary complications.
3. Incidence of other complications.
4. Time required for obtaining negative swab culture.
5. Carrier state.
6. Death rate.

The cases were further divided as early, moderately severe and late on the clinical criteria of extent of patch, duration of disease and toxæmia.

The dosage of the drugs was also standardised as follows : A.D.S. 60,000 units in early case, 80,000 units in moderately advanced case and 1 lac unit in late case. Penicillin was given intramuscularly 2 lac units B.D. for 15 days. Streptomycin was given  $\frac{1}{4}$  gm. daily for 15 days. Terramycin was given 200 mgm by mouth 6 hourly for 15 days.

The analysis of result showed no significant effect of antibiotics over disappearance of patch.

The Penicillin and Streptomycin reduced the pulmonary complications. Terramycin did not reduce the incidence but reduced the mortality from pulmonary complications.

Peripheral circulatory failure was more common in Terramycin treated cases possibly due to the side effects of the drug and due to the advanced stage of the disease.

Neuritis was equally distributed in the 4 groups but was more severe with mortality in control group.

There was no significant effect over the carrier state which was infrequent in this series.

The death rate appeared to be highest in control group—contributed in part by neuritic cases.

The possible fallacies in the trial and the cause of unsatisfactory result with penicillin are discussed.

### 1. Effect of Milk diet in *Trypanosoma evansi* infections in rats.

H. G. SEN, B. N. DUTTA and H. N. RAY, Calcutta.

Recently the effect of milk diet on different protozoal infections has attracted the attention of the parasitologists. It is known that milk has some suppressive effect on the course of infection of mammalian plasmodia (Maegraith *et al*, 1952 and Dutta Chaudhuri and Sett, 1953 and Ramkrishnan, 1953). The mechanism of suppression by this diet has been attributed to deficiency in PABA folic acid and cortisone (Hawking, 1954, Fulton, 1954). But it is still complex to be understood or any of these or other unknown factors may be involved in the growth of the plasmodia. The effect of milk diet on *T. evansi* has not been reported so far and with a view to explore the host parasite relationship, the present study was undertaken.

Two sets of experiments were conducted in 24 albino rats, 12 being used for each set. These 12 rats were divided into two groups, six rats being kept on normal laboratory diet while the other six were kept on pasteurised milk (about 100 c.c. per day per rat). They were preconditioned to milk diet 6 and 9 days before administering the infected inoculum. The average weight in both the groups was about the same. The same dose of infected inoculum was injected subcutaneously to each animal.

The results showed that the average course of infection in milk group was practically identical with that on the normal laboratory diet. Milk diet did not seem to inhibit the progressive growth of the parasites significantly as the flagellates appeared in the blood of both the control and experimental groups almost about the same time. The cytochemical pattern (RNA, DNA, alkaline and acid phosphatase and polysaccharides) of *Trypanosoma evansi* was also not altered during the course of these experiments.

### 22. *Anopheles Culicifacies* as Urban Vector of Malaria in U. P.

H. M. L. SRIVASTAVA, Lucknow.

Four species of Anopheline mosquitos viz. *Anopheles culicifacies*, *A. stephensi*, *A. minimus* and *A. fluviatilis* have been described as vectors of Malaria in U. P. Out of these, so far only *A. stephensi* was considered to be the chief urban vector. Recent dissections carried out of the mosquitoes collected in Lucknow Municipality revealed sporozoite infection in salivary glands of two specimens of *A. culicifacies*. Prior to this *A. culicifacies* was never found as vector of Malaria in urban areas. Usually it is a vector in the rural areas of the State which are either affected with floods or where canal irrigation is practised.

Further investigations are in progress.

### 23. Sandflies of Northern Regions of the Western Ghats.

R. D. MITRA, Poona.

To study the epidemiology of short fevers which occur commonly during and after the monsoon season in Bombay State a "sandfly survey" covering an area of 1500 square miles was carried out in the North-West of this state. 905 sandflies belonging to 4 species were collected from cattle sheds and houses in 5 towns e.g., Mahad, Poladpur, Mahabaleswar, Panchgani and Wai and 39 villages on the eastern and western aspects of the western ghats :—

*P. argentipes* 87, 513; *P. opatasil* 87, 216;; *P. thapari* 1; *P. chakravarti* 1.

Existence of these species in this area was not known before. *P. argentipes*, the notorious vector of *visceral leishmaniasis* and *P. papatasii*, that of Sandfly



fever are uniformly present in large numbers on either side of the hills irrespective of topographical or climatic variations and, therefore, it can be safely assumed that Kala-azar and Sandfly fever exist here. The mean daily temperature, relative humidity, rainfall and other relevant conditions prevailing in this area are optimum for sandfly breeding and transmission of the aforementioned diseases almost all round the year.

It has been pointed out in this paper that there is no relationship between the nature of soil and epidemiology of Kala-azar.

#### 24. The Relationship of Insects of the Genus *Phlebotomus* to Disease.

R. D. MITRA, Poona.

Sandflies disseminate muco-cutaneous leishmaniasis, cutaneous leishmaniasis, visceral leishmaniasis, sandfly fever and are found in nature infected with *Borellia*. They can transmit chronic sores, dermatitis, leprosy, yellow fever, a kind of trypanosomiasis and are suspected to cause epidemics of short fevers including the dreaded war disease—the dengue. 36 species of *Phlebotomus* are found in India. *Phlebotomus papatasi* is considered to be the carrier of sandfly fever on epidemiological grounds. This fever is prevalent during the warm months in the plains of Punjab, Delhi, U.P., Bihar, Bengal, M.P. and Bombay.

Due to an association between the distribution of *P. sergenti* and cutaneous leishmaniasis in India, this species was considered its vector here. This association does not seem to exist now and the vector of this disease in India is not definitely known. The reservoir of *Leishmania tropica* during the inter-epidemic period is also not known. This disease is endemic in the plains of Punjab, Delhi, U.P., M.P., Rajputana desert, Gujerat, Saurashtra and North-Western Bombay but its occurrence has been reported outside these areas.

In India *P. argentipes* transmits visceral leishmaniasis. It is endemic in Assam, Bengal, Madras, Bihar, Orissa, M.P., Eastern half of U.P. as far west as Lucknow, Southern half of Bombay, Poona and Goa. Its incidence in the Army is drawing increased attention. It is believed to be confined to the east and south of a hypothetical line joining Simla and Bombay but its existence west of this line has been recently reported. *P. chinensis* and *P. major*, carriers of visceral leishmaniasis in other countries, occur in India but do not transmit the disease.

#### 25. Antrycide as a trypanocidal drug.

H. G. SEN, H. N. RAY and B. N. DUTTA, Calcutta.

Antrycide is now regarded as a highly effective trypanocidal drug against animal trypanosomiasis. The knowledge about its mode of action is however limited. A series of experiments were undertaken by us to study the disappearance rate of the trypanosomes (*T. evansi*) from the circulation, and the cytochemical changes in the organisms after treatment with antrycide (3 mgm./kg. subcutaneously). The drug acted very quickly on the parasites and the organisms usually disappeared from the peripheral blood between 24 to 48 hours and rarely in 72 hours. The microscopical density of the flagellates were considerably reduced and the viability of these organisms was lost after 24 hours of antrycide treatment. There was also a marked increase of mucopolysaccharides while the enzymatic reaction for alkaline phosphatase was appreciably reduced. On the other hand, such trypanosomes showed an intense reaction for acid phosphatase as evidenced by the heavy deposit of lead sulphide all over their body. These changes in the cytochemical pattern perhaps were the results of the interaction between the cytoplasm of the parasite and the chemotherapeutic agent in the blood and indicated an attempt

in the part of the parasite to neutralize the effect of the drug by producing a eparin-like substance in its cytoplasm.

Relapses usually occurred within 3-4 weeks after treatment. Amongst the treated rats the relapse rate so far observed was found to be 28% (50 treated, 14 relapsed). In all relapse cases the spleen was abnormally enlarged. It was interesting to note that the size of the spleen during relapse was almost the double of that seen in acute stage of the disease.

## 26. "Clinical Trial of 'P-267' in Ophthalmic Surgery".

R. B. ARORA, B. N. CONSUL and V. N. SHARMA, Jaipur.

Our previous work on this compound (paper was read at 41st session of Indian Science Congress Association) which is chemically 4 n-butoxy B-(1-piperidyl) propiophenone HCl, showed sufficient promise to warrant further clinical trials.

96 intraocular and 36 extraocular operations have been done with 0.5% 'P-267'. For comparison 98 intraocular operations were performed with 5% cocaine and 54 with 1% anaethane.

'P-267' is required to be put in the eye only once and takes about  $\frac{1}{4}$ th of time taken by cocaine and  $\frac{1}{3}$ rd of anaethane to produce the same degree of anaesthesia and of same duration. This rapid onset of anaesthesia has an obvious advantage.

It does not cause dilatation of pupil and intraocular tension is not increased so it can be used with advantage in complicated cases and glaucoma.

The post-operative complications have also been found to be much less than with cocaine and anaethane. It has further been found to be completely non-toxic to the spongy iris tissue.

Hence in our experience 'P-267' is a better anaesthetic in ophthalmic surgery than cocaine and anaethane.

## 27. 'Action of commonly used intravenous anaesthetics in Medical and Veterinary practice, on the Automaticity of Auriculo-Ventricular node.'

R. B. ARORA and P. K. DAS, Jaipur.

Effects of Evipal, Thiopentone and Pentobarbital have been studied on experimentally produced Auriculo-Ventricular nodal rhythm in 40 dogs.

Evipal and Thiopentone in small doses stimulated the A.-V. node while in higher doses and Pentobarbital depressed the node, which was maximum within one minute of injection and was in proportion to doses.

The nodal depressant potencies observed with 20 mg./Kgm. were—Evipal 1.0, Thiopentone 2.5 and Pentobarbital 6.5. Thiopentone and Pentobarbital in 20 mg./Kgm. depressed A.-V. node permanently.

Repeated administration of Thiopentone showed subsequent doses to depress A.-V. node more in degree and duration.

Diminution of speed of injection to  $\frac{1}{4}$  showed no significant differences.

Lead II and Unipolar Pericardial Lead recorded by Grass Inkwriting Oscillograph showed most predominant effect of T wave which was either depressed or inverted, with or without depression of S-T segment and broadening of QRS complex. Cardiac irregularities seen with Evipal and Pentobarbital in 40 and 20 mgm./Kgm. respectively were of the nature of ventricular extrasystole and A.-V. block.

These have been found to have direct action on the junctional tissues of heart and myocardium as is evidenced by alteration in cardiac rhythm and electrocardiographic changes. The depression varied with type of anaesthetic, dose given at one time and the total dose given.



**28. 'Pharmacological investigations of Di( $\beta$ -O-Methoxyphenyl-isopropyl)—amine lactate (U-0069 code name): A new local anaesthetic'.**

R. B. ARORA and V. N. SHARMA, Jaipur.

This new compound was prepared by Upjohn Co., Michigan, and was sent to the authors for Pharmacological investigations.

As a surface anaesthetic on guinea pig cornea 0.01% was the minimum concentration necessary to produce topical anaesthesia in all the animals tested. 0.03% was found to be the median effective concentration, 0.05% is the concentration that produced a duration of anaesthesia equal to the effect of 2.0% cocaine (20 minutes). It is therefore 40 times more potent than cocaine from anaesthetic duration point of view. The highest concentration tolerated was 0.5%.

As an infiltration anaesthetic in guinea pigs it is 30 times more potent than procaine from the point of anaesthetic duration and by incorporating toxicity and activity data into a therapeutic ratio U-0069 was found at least 8 times better than procaine.

It was found to be superior as a broncodilator against pilocarpine and histamine bronchoconstriction as studied by the isolated rabbit lung technique when compared with ephedrine. But it is somewhat less potent against acetylcholine constriction.

When compared with ephedrine it showed 45 times antihistaminic and 20 times anti-cholinergic activity than that of ephedrine as shown by the study on rabbit isolated ileum.

This promising local anaesthetic and bronchodilator needs clinical screening.

**29. Toxicity of Injectio Mersalyl, B.P., and Diethylamine-Acetarsol.**

A. N. BOSE, Calcutta.

Depending upon the method of preparation, organometallic compounds may vary in toxicity from batch to batch. Injection of Mersalyl B.P., and injection of Diethylamine-acetarsol are used now-a-days from various therapeutic purposes. In order to establish suitable test doses of these preparations for routine checking of different batches, toxicity tests on white mice were carried with highly purified preparations of both these preparations. With injection of Mersalyl B.P. (containing 5% theophylline), the intramuscular LD<sub>50</sub> was found to be 1.35 c.c. per kg. and the test dose for assay was taken to be 1.28 c.c. per kg. with a true mortality of 33% ( $P=0.99$ ). The LD<sub>50</sub> of Diethylamine-acetarsol was found to be 0.4217 mg. per gm. The test dose for assay for this preparation was accepted to be 0.35 mg. per gm. with a true mortality of 18% ( $P=0.99$ ).

**30. Glucose Tolerance in Health and in Typhoid Fever.**

SACHCHIDANANDA BANERJEE, Calcutta.

Glucose tolerance test was performed in normal subjects, in patients suffering from typhoid fever and in persons convalescing from typhoid fever.

Normal fasting blood sugar level was 75 mg. per 100 c.c. blood. After an intravenous injection of 50 c.c. of 50% glucose blood sugar level became maximum (117 mg.%) in half an hour's time and within one and half and two hours the level came down to normal or below normal. The average blood sugar level in the fasting condition in patients suffering from typhoid fever was 85 mg. % and the value became maximum (179 mg. %) half an hour after the injection of glucose but this value never reached the fasting blood sugar level at the end of two hours. The blood sugar remained at a higher level in all the stages in comparison with the normal. In persons convalescing from typhoid fever the fasting blood sugar

vel was 77 mg. per 100 c.c. The blood sugar values at different intervals of time after administration of glucose were at lower levels in comparison with the values of patients suffering from typhoid fever and at higher levels in comparison with the normal persons. The decreased tolerance to glucose might be due to lowered ascorbic acid level of blood of patients suffering from typhoid fever.

### 1. Significance of Sodium Clearance Test in Cases of Ascites due to Cirrhosis of Liver.

DR. R. M. KASLIWAL and DR. RAM AVATAR SHARMA, Jaipur.

Sodium clearance test was performed in 5 normal persons in order to find out the excretion of sodium in such persons under normal diet, under sodium restricted diet and under sodium restricted plus high protein diet, and the figures worked out in these limited cases were as follows :—

Sodium clearance on normal diet ranged from 0.77 to 2.46 Mean normal sodium clearance was 1.45.

Sodium clearance on restricted sodium diet ranged from 0.02 to 0.09 mean value 0.057.

Sodium clearance on restricted sodium diet plus high protein diet ranged from 0.06 to 0.1 mean value 0.078.

13 cases of ascites due to cirrhosis of liver and mypoproteinaemia were also tested for sodium clearance test under similar conditions i.e. under normal diet, under sodium restricted diet and under sodium restricted plus high protein diet. In 5 of these cases sodium clearance figures increased on increasing proteins in sodium restricted diet from mean value 0.038 to 0.509 and these were just the cases who showed subsequent clinical improvement while in other cases where the clearance value remained the same or decreased no clinical improvement was seen and some of these patients became worse. Thus this test appears to have a definite prognostic value in such cases of ascites.

### 32. Effect of Sewage and excreta disposal methods on Intestinal Parasites.

T. R. BHASKARAN and M. A. SAMPATHKUMARAN, Calcutta.

Current sewage and excreta disposal practices in our country have not been studied so far in relation to their efficiency for parasite removal. An estimate of the extent of public health burden imposed upon the population due either to complete absence of treatment facilities or improper methods of disposal is also lacking. The available literature on these aspects of the problem is confined at present to work carried out in America, England, South Africa and elsewhere. The authors therefore, undertook a study of the effect of sewage and excreta disposal methods on the survival of intestinal parasites at different stages of treatment. The results embodied in this paper, cover a period of two years observations.

A suitable laboratory technique was first standardised to recover ova of ascaris, hookworm and trichuris, from heterogeneous material like sewage, sludges and compost. By employing this technique it was possible to quantitatively enumerate the total number of parasites present in sewage, effluent and sludge samples. Samples for chemical and microscopic studies were collected from the existing treatment plants at Bhatpara, Belur and Batanagar and an experimental trickling filter pilot plant at Bhatpara, maintained under controlled conditions. Data are presented in a table relating to the efficiency of parasite removal by treatment methods such as primary sedimentation, septic tank, septic tank cum trickling filter, stone bed, activated sludge and sludge digestion. A new method of estimating the total number of eggs discharged per capita per day has been developed based upon the B.O.D. figures. From analysis of the results obtained, it is concluded that at least primary



sedimentation or septic tank treatment is an essential requisite for effective removal of ova. It is also seen that proper operation of the treatment plant is equally important in bringing about efficient removal of these parasites.

The effect of composting refuse with human excreta on the survival of intestinal parasites was studied by taking samples from compost heaps maintained in Naupara trenching ground under controlled conditions. A number of compost samples obtained from different parts of India were also analysed and the results of bacteriological and microscopic examination are presented in a table. It is concluded that the majority of parasitic ova are killed during the composting process, if the compost heaps are properly supervised and maintained in good conditions. However, further work is necessary to carry out statistical analysis of results to draw clear cut conclusions for the guidance of public health departments in our country.

The significance of these observations in use of excreta, sewage and sludge in agriculture is also discussed.

### 33. Total and "Available iron" in some foods.

S. B. LAL and S. P. ROY CHOWDHURY, Patna.

Proximate principles of foods of Bihar, except iron, have been reported by Mitra and Mittra (Ind. Jour. Med. Res. 1942-30—229, 1943-31—41; 1945-33—91). The iron (total or 'available') intake of the people of this State has been assessed on the figures of other States of this country or of abroad. This is liable to considerable error in view of the variable iron content of soil and variation in climatic conditions. 128 types of foods (cereals 24, pulses 13, leafy vegetables 15, other vegetables 23 roots and tubers 13, nuts and seeds 8, fruits 16, condiments 9 and miscellaneous 7) were analysed for total iron, 'available' iron and percentage of 'available' iron in total iron, the latter two being of more nutritional importance. Estimations were done by Chemical technique of Hill (Proc. Roy. Soc., Lond., series -B, 1930-107-205) and Ranganathan (Ind. Jour. Med. Res., 1938-25-677), recovery value was  $100 \pm 6$ . Contrary to popular belief leafy vegetable showed a low figure. Foods having 50 per cent or more of 'available' iron in total iron were: Sanwa millet (72.1), Semolina (55.6), Whole wheat flour (50.8), Maida (59.3), Kabuli Channa (69.7), Lentil (69.2), Potato (55.1), Amra (86.6), Vegetable marrow (69.1), Suthni (*Dioscorea fasciculata* 90.9), Linseed seeds (87.7), Musk melon (Kharbuja—73.7), Green Plantain (56.6), Omum (64.9), Green tamarind (74.9), Barley powder (51.2).

### 34. Consumption in Yet Another Food Scarcity Areas of Bihar.

S. B. LAL, Patna.

Successive periods of partial draught followed by almost complete failure of rains—the only source of irrigation—in 1952, precipitated acute food crisis in some of the villages in the Districts of Monghyr and Ranchi. Assessment of their dietary intake was made as also those of normal areas of Ranchi. The income of people of the scarcity areas had dropped and they had to sell off their livestock at a nominal price for sustenance. People of Monghyr were getting relief from Government, their intake was 14.38 calories, whereas in Ranchi it was as low as 796. Details of unusual foods consumed by them and their proximate principles have been described. These were not the foods in normal times. Adults in Ranchi had Oedema, localised or generalised and children had 128 gross nutrition defects. Intake of almost all the nutrients was much lower than the people of normal areas and the suggested Indian Standard.

### 5. The Bibliography of Indo-European Contributions to Tropical Medicine.

DR. D. V. S. REDDY, Madras.

Most of the Histories of Medicine, written by American and European scholars, devote a few lines or a few paragraphs, to ancient Hindu Medicine (Ayurveda) but generally omit to mention the great names and contributions from India to Tropical Medicine, in the 18th and 19th centuries. Still more surprising is the scant space allotted in monographs on Tropical Medicine and in books on the history of Tropical Medicine to the large number of reports, researches, monographs and treatises, from India, by European physicians and surgeons and specially by that small but immortal band of British Medical men, serving on the establishments of the three Presidencies in India. Results of a search for such books are presented with photographs and lists.

Our own India and medical men of the present century in India, the teachers of our medical schools and the few investigators, scattered here and there, have not even heard of these mines of knowledge. Post-graduate students, preparing theses for degrees, or articles to Medical Journals, are blissfully ignorant of these treasuries of clinical observations, post-mortem findings and lines of treatment. In the course of historical survey of a disease or observation of clinical interest or a drug or mode of treatment, Indian writers begin abruptly with 1,900 or preface the article with the reported or distorted statements from Hippocrates, Galen, or Sydenham. It would be more in consonance with the new spirit of free India and Indianising the studies at the University levels, if our Universities and Journals insist on the study and survey of Regional Indian and indigenous literature, on the particular branch of Medicine or on the particular subjects under discussion. Co-operation from public and private libraries in India and abroad, of WHO and UNESCO is needed for the preparation of an exhaustive bibliography which is bound to be useful not only for India but to all Nations.

### 16. Dhanvantri Mahal of Raja Serfoji of Tanjore. (An Institute for Medico-Historical Studies and Clinical Research in the First Half of 19th Century.

DR. D. V. S. REDDY, Madras.

One of the recommendations of the Bhoze Committee is the organisation of an Indian Institute of History of Medicine, with Medico-Historical Library, Museum and Modern tools and equipment for Medico-Historical Researches and publications. Such institutions came into existence in Europe, only after 1900 and in America, only during the last two decades. But, England, France, Germany, Italy and even the new World had very old collections of Medical manuscripts, incunabula, early printed classics, which could be utilised for Medico-Historical Researches. Equipment and facilities were added and pioneers created groups of trained workers in this field.

India is in a different position to-day. During the last 150 years, our manuscripts were exported to foreign countries. Other manuscripts disintegrated for want of care. Large bundles were deliberately burnt or scattered to the winds. There are still a few cities and states where old manuscripts and old printed books are preserved, though not cared for, or used, for some generations.

As a Prince, Serfoji came under the influence of a Missionary, Schwartz, who stimulated the youngman's interest in historical and scientific studies. When the enlightened young became the Rajah of Tanjore, he spared no pains to secure from every part of India manuscripts in Sanskrit, as well as in Indian languages, particularly Tamil, Telugu, Marathi, etc. Where original manuscripts could not be secured, he had copies made for his collection. The only manuscript of Bhela Samhita, was discovered in Tanjore. There are many more rare manuscripts not



available in other collections. Some of the epics and scientific treatises are illustrated. Serfoji studied Medicine with the help of both the Indian and the European physicians. He imported a large collections of Medical books, chiefly in English and some in Continental and classical languages. In every one of his books, he has left his signature and date of receipt. He was not a mere scholar and amateur in Medicine. Under his personal supervision, cases were examined daily, treated with different methods, Sidha, Ayurveda, Allopathy etc. How modern and scientific he was, can be noted by the perusal of the Volumes of books written in Tamil as a sort of 'Encyclopedia of Medicine' embodying the results of the study of the various systems and books and observations made by himself and his learned native pandits and Vaidyas and European scholar-physicians. Life sketch and photos of Serfoji and his collections will be shown.

Now that we have a people's Government, with scholars and patriots at the helm of affairs, Serfoji's Dhanvantari Mahal, can be taken over by Government, reorganised, rennovated, re-equipped, on modern lines, with modern appliances for taking photo-stats and micro-film copies etc., and utilized as an Indian Institute of History of Medicine, instead of waiting for land, buildings, book collections, etc.

## **B. VETERINARY SCIENCES**

### **37. A Study of Variation in Butter fat content of a Herd Milk pool for the Haryana Breed.**

L. D. AHUJA and A. N. GAUTAM, Izatnagar, U.P.

639 morning and 638 evening milk samples obtained from the Haryana breed of cattle of the Animal Genetics Division at the Indian Veterinary Research Institute, Izatnagar during the years 1952 and 1953, were analysed for their butter fat content. The analysis revealed that while the average butter fat content for the entire period was 4.8%, the evening milk (average 5.03%) was always richer than the morning milk (average 4.55%). The difference was statistically significant. The effect of season was also apparent, January being the best butter fat per cent producer and May the poorest. Rainfall seemed to depress butter fat production but the effect was statistically not significant.

### **38. Cleaning and Sterilisation of Dairy Plants.**

SATYA RANJAN SARKAR, Haringhata (W. Bengal).

The paper deals with the sterilisation test of the various parts and equipments of the pasteurisation plant, to get a thorough clear and comprehensive idea about the efficiency of sterilisation, noting that the efficient sterilisation is as important as the process of pasteurisation itself.

The sterilisation test of the pipe lines showed satisfactory results by soaking them at 2.5% alkaline (sodium carbonate) solution at 50°C for 20 minutes and then steaming for  $\frac{1}{2}$  an hour.

The bottle filling machine and the milk reservoirs showed quite satisfactory results by steaming generally at 30 to 35 lbs. pressure per sq. inch for 3 to 5 minutes when the sterilisation was complete.

Satisfactory results were obtained in the sterilisation test of the cans by maintaining the strength of the sodium carbonate at 0.66% to 0.7% of the can washing solution.

The bottles provided a very difficult problem in the effective sterilisation. Various concentrations of the dairy detergent i.e. caustic soda and the proportion

Calgon (Sodium Metaphosphate) used, at variable temperatures were studied. The best and satisfactory results were obtained by maintaining the strength of caustic soda at 3.0% and temperature at 150°F keeping the proportion of Calgon and Caustic Soda in the ratio of 1 : 8.

### 9. Blood Studies in Relation to Neck Molting in Poultry.

P. C. SAWHNEY, Izatnagar.

Due to an unusual behaviour of some birds at the Farm to come into molt in November, it was thought desirable to study the possible relationship, if any, between the degree of molting and the cholesterol content of blood. The affected birds belonged to White Leghorn breed. Of the three birds affected, one had only low cholesterol content as high as 785.70 mg./100 c.c. blood. The cholesterol content of the non-affected birds was varying between 185.71 to 425.0 mg./100 ml. blood. Pure *Desi* and Rhode Island Red breeds showed less blood cholesterol. Birds of W. L. H. breed showed higher haemoglobin and cell volume than birds of either pure *Desi* and Rhode Island Red breeds.

### 10. Experiments with Built up Litter for Raising Chickens.

S. BOSE, S. G. IYER and H. P. TANDON, Izatnagar.

In western countries where poultry keeping on a commercial scale is a specialised occupation, every minute aspect of poultry husbandry is probed into and improved methods are developed from time to time. Poultry keepers usually are in the habit of rearing chickens on clean floors or when they use litter it is changed frequently with a view to obviate the risk of dissemination of parasitic conditions. There have been a few reports during recent years from U. S. A. on the economics of built-up litter for raising chickens. The workers have not come to a general agreement in all the cases. Experiments have therefore been made at the I.V.R.I., Izatnagar with purebred chickens using built-up litter. When the thick layer of litter on the floor of chickens houses is allowed to stay on for considerable periods but stirred daily to allow dehydration, the risk of incidence of transmissible parasitic conditions was minimised to the bare minimum. Further the chickens reared on built-up litter (Wheat Bhoosa) showed distinct weight increases and less mortality over the control. The beneficial growth results were due to the intake by the chickens of Vitamin B<sub>12</sub> and other natural growth promoting factors produced by the microflora of the droppings.

### 41. Carotene Content of Common Poultry Feeds.

P. C. SAWHNEY, Izatnagar.

The value of vitamin A, in the nutrition of poultry is of great importance both for the health of the birds and the production of eggs of good quality. In view of the importance of vitamin A, and the lack of data on the subject of common poultry feeds. 30 samples of cakes, cereals and their by-products and green feeds were evaluated for the carotene content. Pigment was estimated by Biochem. Absorptiometer. Of the samples examined, cereals and their by-products seem to contain negligible amounts while green feeds contain fairly high amounts. *Triticum Alexandrinum* and *rigonella faenum graecum* contain the highest amounts of the samples examined.



**42. Studies on the Effect of the Addition of Yeast Sludge in Normal and Simplified Laying Rations.**

S. BOSE, S. G. IYER and A. K. PAL, Izatnagar, U.P.

The byproducts of the fermentation industries contain yeast and yeast-formed substances. They contain liberal quantities of proteins and are valuable sources of the B-Vitamins and have, therefore, considerable value in livestock feeding. A local sugar factory manager who have licence to produce power alcohol placed at our disposal large quantities of yeast sludge which were just going into the field as manure or waste.

Experiments were carried out with, (Gr. I) yeast sludge when used as a supplement to a low cost laying mash, (Gr. II) normal laying mash, and (Gr. III) yeast sludge when used as supplement to the normal laying mash. The birds were housed in laying batteries and the records of egg production, egg weight, food consumption, protein percentage, food utilisation and mortality, during five months' experimental period, were studied. The percentage of egg production in Groups I, II and III were 25.8, 38.5 and 45.7 respectively. It is interesting to note that a supplement of 10 per cent yeast sludge to a supposedly normal laying ration, produced 7.2 per cent increase in egg production. The yeast sludge which is a waste product in fermentation industries has, therefore, a significant supplementary value in the poultry ration.

**43. Studies on the Utilisation of Vitamin B<sub>12</sub> and Antibiotics in Poultry Feed.**

S. BOSE, H. P. TANDON and S. G. IYER, Izatnagar.

In the production of chickens or eggs, feeding alone represents about 60 per cent of the total cost of production. Due to the acute scarcity of cereals and animal by-product in the country, the possibility of more economic feeding was explored.

Fortracin-6 an antibiotic and vitamin B<sub>12</sub> feed supplement, obtained through the courtesy of S. B. Benick & Co., New York, was fed under controlled conditions, one in thousand level, to a standard poultry mash to large number of pedigree chicks of white Leghorn breed beginning from day-old.

An analysis of the growth-rate of the chicks revealed that the chicks fed the ration supplemented with Fortracin-6 developed a distinct weight advantage over the control chicks at every stage of growth. The chickens in both the groups had a good health record, while the mortality percentages were 7.2 and 3.6 for the control and experimental groups respectively.

The approximate cost of the Vitamin B<sub>12</sub> supplement Ex-Calcutta was Rs. 12/- per pound and it cost six pies to feed one chick up to the age of eight weeks at a level of 1 in 1000.

**44. Economics of Different Breeds with Reference to Eggs Production.**

S. G. IYER, S. BOSE and H. P. TANDON, Izatnagar.

In the five year Plan, it is expected that livestock improvement will be one of the features. Realising the importance of poultry and eggs in the human diet both the State and Central Governments are launching large scale projects to improve the non-descript varieties of fowls forming the bulk of poultry population in India. A number of pure breeds and crosses of fowls are maintained at the I.V.R.I., Izatnagar for rendering help to the States. The choice of breed in starting poultry business is often a vexed question. After intensive experimen-

ion and selective breeding over generations since 1939 the laying performances of the different pure breeds in descending order stand as under :—Rhode Island Red, White Leghorn, improved Desi (Indigenous) and Barred Plymouth Rock. The crosses in our experiment actually represent upgraded fowls using sires of different pure breeds. The laying performances of the crosses in descending order are as follows :—Rhode Island Red x, white Leghorn x and Barred Plymouth Rock x.

#### **5. Influence of Body Weight of Pullets on Fecundity.**

S. G. IYER and H. P. TANDON, Izatnagar.

The correlation between body-weight of pullets of 3 different breeds at 24 weeks of age, and their total annual egg production has been studied.

For convenience in respect of body-weights, the birds were divided into 3 classes respectively; heavy, medium and light types in the different breeds.

In the White Leghorns the lighter birds laid better than the medium sized and heavy ones.

In Rhode Island Red and the improved Desi pullets, birds of higher body-weights tended to lay better. This finding is of great economic value in respect of the Desi fowls, in which case egg production and body size can both be simultaneously increased by selection. Statistical analysis, however, did not reveal significant correlation, between the two characters.

#### **6. Studies on Up-grading of Indian Poultry.**

S. G. IYER, H. P. TANDON and S. BOSE, Izatnagar.

With a view to improve the non-descript unattractive fowls of India, which represents nearly 98 per cent of the total poultry population, fundamental research and controlled experiments under conditions prevailing in U.P. (Izatnagar), were undertaken in a systematic manner in 1939 simultaneously with mass multiplication of exotic breeds.

Male birds of the commonest utility breeds namely White Leghorn, Rhode Island Red, Barred Plymouth Rock which have proved their worth in the different parts of the country during the last three decades or so, were mated to, in the first instance, selected females of a pure Indian variety of poultry resembling the Brown variety of Leghorn. The first generation progeny of chicks were reared, selected females were again mated to the male birds of the same breed as that of the sire used for producing first cross. Thus up-grading of unimproved poultry was initiated and to-date work has progressed satisfactorily up to the 6th cross generation. At each of the generations the crossbred male chickens were eliminated for table or other experimental use.

The results show clearly the fluctuation of egg production with a trend towards improvement and a significant progressive improvement in egg size in the case of the graded fowls. Summing up, egg production has definitely improved and the improvement has been maintained satisfactorily, in the subsequent generations. The laying performance of the pure breeds viz. White Leghorn, Rhode Island Red and Barred Plymouth Rock which was always better than the indigenous fowls, also showed variation from generation to generation, parallel with selective breeding for progressive improvement of the economic qualities. The policy of government now in respect of the poultry improvement plans is to foster up-grading schemes in the rural areas as a National Plan, the method being the quickest and most economic for the improvement of ordinary farm stocks.



**47. The Influence of Caponisation on the Carcass Composition, Edible Meat content and Palatability of Chicken of the Same Age and Breed.**

T. S. KRISHNAN, V. SEETHARAMA RAO and T. D. MAHADEVAN.  
Izatnagar.

The experiment to find out the influence of caponisation of chicken on the carcass composition, edible meat content, and palatability, was undertaken. The caponisation was performed by surgical operation. The breed taken up was B.P.R. × Desi graded to third generation and aged about 14 weeks.

It was observed that caponisation brings about an increase of about 17% on live weight over the controls and the fat content of the capon was very much higher than the control. Also the total edible carcass constituted a slightly higher percentage of the dressed weight in the capon over the controls.

Among the different cuts of the chicken, the breast constituted the highest percentage of edible meat viz. over 80% followed by thighs, drum sticks, back and wings. On a consideration of all the data it would seem justified to state that caponisation improves the palatability particularly its flavour and juiciness and at the same time brings a better return under identical feeding and management conditions. It is also interesting to note that even a very small amount of testes is sufficient to bring about a development of the secondary sexual characters.

**48. Prevalence of Infectious Coryza amongst Pigeons.**

ANUPAM CHATTERJEE, Nuxalbari, W. Bengal.

Cases of Infectious Coryza occurring in Pigeons have been recorded with their short symptomatology. Five sets of trials with different medicines were carried out in different batches of equal number of pigeons and it was observed that best results were obtained with Dihydro-Streptomycin Sulphate. Sulphathiazole came next in order of merit. The recovery was as high as 100% and 70% respectively.

Dr. Kessen's method of immunisation was attempted at to produce an immunity and, in a batch of 24 pigeons vaccinated with nasal-exudate-saline solution and equal number of controls, the controls died when exposed to natural infection while the vaccinated birds resisted the infection.

The author is of the opinion that both the method of treatment and vaccination as described being easy and uncomplicated, can be extensively used in the field in order to achieve a high level of success.

**49. Successful Chemotherapy of Avian Pasteurellosis with Sulphamezathine.**

S. B. V. RAO and B. M. THAKRAL, Izatnagar.

Chemotherapy with Sulphamezathine 16% Sodium Solution (I.C.I.) at 0.2% level in drinking water, proved successful in controlling both acute and chronic forms of fowl cholera when dosed continuously for three days, with a break of one day, and repeated for a further period of 3 days with a view to eradicate residual "Carrier" infection if any, in the flock.

**50. Studies on the effect of multiple primary infections upon a subsequent infection of *Ascaridia galli*, Schrank, 1788, in Chickens.**

P. G. DEO and H. D. SRIVASTAVA, Izatnagar.

The results on the effect of multiple primary infections upon a subsequent infection of *A. galli* in chickens have been incorporated in this paper. In the

control group 13.6 worms per bird had developed from the primary infection of 10 infective eggs per bird, while in the experimental group, 13.4 and 0.0 worms per bird had developed from the four primary repeated infections of 200 eggs each, and the single secondary infection of 200 eggs per bird respectively. The primary infection of the control group was similar to the secondary infection of the experimental group, both being administered at the age of nine weeks.

It was, therefore, evident that the repeated primary infections of this parasite increased the acquired resistance of chickens and thus enabled them to throw off subsequent infection of this parasite.

#### 1. Haematological Studies in Indian Goats.

N. K. DAS and D. P. SADHU, Calcutta.

No studies have been undertaken on the Haematological investigation of Indian goats. In the present work, goats of Jamnapuri breed were selected. Blood of adult male goats was withdrawn from Jugular vein in oxalated tubes. Investigations were undertaken on total count (R.B.C. and W.B.C.), differential count, haemoglobin content, Corpuscular volume, E.S.R., M.C.V., M.C.H., and M.C.H.C. Values found for the normal goats, are the following:—

Total count:—R.B.C.—13'33 million per c.m.m., W.B.C.—11,770 per c.m.m.; Differential count—Poly—39'5% (approx.), Lympho—52%, Mono—7%, Eosino—1'5% (approx.), Baso—0%; Haemoglobin content—10'5 grm. per 100 c.c. blood; Corpuscular volume (Haematocrit)—30%: E.S.R.—1'07 mm. in 2 hrs.; M.C.V.—22'87  $\text{Cu } \mu$ ; M.C.H.—7'4  $\gamma\gamma$  and M.C.H.C.—33'4%.

#### 52. Bio-chemical studies in the blood of normal goats of Jamnapuri breed.

S. B. CHOWDHURY and D. P. SADHU, Calcutta.

No investigations on the Bio-chemical constituents of blood of Indian goats have been undertaken in Bengal. A knowledge of the normal values is a prelude to the successful treatment of diseases in goats as well as in the undertaking of ways and means to increase the productive efficiency of Indian goats.

In the present war blood sugar has been estimated by Hagedorn-Jensen method, chloride by the method of Whiteborn, calcium by Clark-Collip modification of Kramer-Tisdall method, inorganic phosphate by the method of Fiske and Subba Row, cholesterol by alcohol-ether extraction and developing the colour by acetic anhydride method and N.P.N. by Folin and Wu method. The normal values are as follows:—

Blood sugar—51'7 mg.; Calcium 10'4 mg.

Chloride as NaCl—492'4 mg.

Inorganic phosphate—4'1 mg.; Cholesterol—138'9 mg.; and

N.P.N.—41'2 mg.

#### 53. Measurement of Surface Area in Goats.

S. P. BHATNAGAR and D. P. SADHU, Calcutta.

Energy metabolism depends upon the surface area. An attempt has been made to find relationship between surface area, height and weight of Indian goats.

The surface area is measured by a newly devised surface integrating wheel. This instrument consists of a wheel of a variable diameter and breadth. Arrangement has been made to hold a chalk over the wheel so that with the movements of the wheel lines can be marked at a distance equal to the breadth of the wheel.



over the skin of the animal. With each completed revolution of this wheel, a circular disc engraved with a scale moves by one division so that the number of revolutions can be read off hand from this disc. In this way the surface area of goat has been measured and has been found to be slightly higher than in goats of cold climates.

#### 54. Studies on deep freezing of buffalo semen.

P. BHATTACHARYA and P. N. SRIVASTAVA, Izatnagar.

In this paper, the results of preliminary investigations carried out to preserve buffalo spermatozoa at sub-zero temperature by the technique of deep-freeze are presented. No statistically significant difference was observed between the various levels of glycerol used at 5°C and -79°C in the proportion of sperm which survived the treatments. It has also been observed that more rapid cooling between the critical temperature range (-14.0°C to -26.0°C) resulted in a higher percentage of survival of spermatozoa as compared to the lower rate of cooling within this range. Further investigations are being made.

#### 55. Influence of factors affecting sex drive on semen production of buffaloes—II.

S. S. PRABHU, Izatnagar, U.P.

Results are presented of a series of experiments conducted on 14 buffalo bulls to study the effect of (1) substituting a male for a female as a 'teaser', (2) using different males as 'teasers', (3) using different coloured females as 'teasers', (4) giving 5 minutes cold shower bath prior to collection, (5) making collections in the evening instead of in the morning and (6) making collections at night instead of during the morning, on the reaction time and semen quality. Only limited period effects were tried. The period consisted of 3" "tries" of 5 minutes duration each. The treatments were changed following the well known statistical design of experimentation namely "switch back" design. Significant variation was obtained in respect of (1) *reaction time* when a male was substituted for the routine female as a 'teaser', (2) *percentage of abnormal sperm* in the second ejaculates of the second experimental series with male as a teaser', (3) *percentage of abnormal sperm* in the first ejaculates of experiment with different coloured 'teasers', (4) *initial motility* in the first ejaculate of experiment in which the bulls were subjected to a shower bath prior to collection and (5) *sperm concentration* in the first ejaculate of experiment in which collections were made at night. In the rest of the cases and items studied, no significant difference could be detected.

It was observed that bulls with lower sex drive showed greater reaction to change in the excitatory object or change in time of collections than bulls with higher sex drive. Estimates of sex drive taken for this purpose were the over experiments, over ejaculates average reaction times. The paper also includes description of certain peculiar sex behaviour patterns observed in some bulls.

#### 56. Retention of Placenta in the Bovines.—A Clinical study on the efficiency of Stilboestrol in the expulsion of the placenta.

ANUPAM CHATTERJEE, Nuxalbari, W. Bengal.

The object of this paper is to review the literature on Retained Placenta and at the same time to discuss the beneficial results following the oral administration of Stilboestrol, a synthetic derivative of Stilbene, in causing a nonmanual expulsion of the retained membranes. As such, the available literature on retention of placenta, its causes, symptoms and treatment have been reviewed on one hand, while on the other, some typical case records have been described.

Twelve cases of Retention of Placenta were treated by the author during the year 1952-53. Some of them were cases of simple retention, while others were complicated with symptoms of foetid discharge and other systemic disturbances. The cases of simple retention responded to Stilboestrol therapy alone, and the placenta were expelled generally on the third or fourth days. The cases of complicated retention were also treated with Stilboestrol, while some form of Alpha-drugs were administered side by side to combat the secondary infections. In these cases too, the retained membranes were expelled within three to four days and the animals were cured. The dose of Stilboestrol was 25 to 30 mgm. given daily, the tablets being crushed to powders, mixed with water and drenched to the animal. The total dose varied from 75 to 100 mgm. according to cases.

## 7. Rhinosporidiosis in Bovines in Bombay State.

R. M. KALAPESI and B. L. PUROHIT, Bombay.

A case of Rhinosporidiosis from a Bovine has been recorded for the first time in Bombay State. Reference about histo-pathology, probable mode of transmission, possibility of infection from animals to man and vice versa and the treatment have been made.

A systematic search and careful investigation particularly of cases clinically diagnosed as Nasal Granuloma is advocated as it might reveal higher incidence.

## 8. The Chemotherapeutic Properties of Sulphadimidine—a Clinical Study.

ANUPAM CHATTERJEE, Nuxalbari, W. Bengal.

This paper deals with a few records of cases treated successfully with Sodium Sulphamezathine. During the year 1951-53, the author treated 3 cases of Fistulous Withers in horses, 25 cases of complications of Foot and Mouth diseases in cattle, 10 cases of the Foot in cattle and 5 cases of Actinomycosis in cattle, all with Sulphamezathine, Sodium, administered either as injections, or by oral routes. 85% success in cure was obtained and the author concluded the following merits of the drug against the diseases :—The drug is most rapidly absorbed and distributed in different body fluids, exerts a most rapid action, one or two injections are sufficient to effect the cure, and the drug is most effective to control such infections. In the conclusion, the author has reviewed the literature, both foreign and Indian, and on the efficiency of Sulphamezathine Sodium against various diseases as found in veterinary practice.

## 59. Neural Block—its Application to Ophthalmology.

ANUPAM CHATTERJEE, Nuxalbari, W. Bengal.

A technique of Neural block to fix up the cornea and eyeball for the surgical removal of the eyeworm *Thelazia Lachrimalis* has been studied and the results have been recorded in this paper. Three different local anaesthetics, Novocain, Plainocaine and Anethaine, were selected and injected in different strengths in the space between the malar bone and the alveolar border of the mandible and directed towards the Foramen Lacerum Orbitale. The idea was to get all the nerves supplying the eye in a group during their exit through the foramen and to produce a nerve-block therein. Successful anaesthesia was produced in time from three to six minutes, according to the drug, and the operations were carried out with cent per cent success. Credit has been given to Dr. Wilson of the Madras Veterinary College for the valuable suggestions in this paper. After discussing all the possible factors associated with this technique, the author con-



cludes that this technique can be adopted safely as a parallel technique of anaesthesia of the eyeball and its appendages. He also concludes that amongst the list of anaesthetics used, Novocain is the best for such a purpose.

#### 60. A preliminary report on the incidence of Surra and Tabanus flies in Rajasthan

P. BALARAMA MENON, Izatnagar.

This report presents for the first time data regarding the incidence of surra and *Tabanus* flies in Rajasthan and Ajmer. Though the area is generally dry, surra is prevalent in camels in Rajasthan. There is an increase in the incidence of surra in the post-monsoon months which continues during the early part of winter and gradually declines towards summer. The disease is more common in the moist regions viz., eastern half of Rajasthan including eastern half of Jodhpur Division. Udaipur and Kotah are the two Divisions affected most.

It has also been established for the first time that transmission of surra can take place in the area through the agency of *Tabanus* flies which are present in all the Divisions of Rajasthan and Ajmer and which can breed and complete their life cycle under conditions prevailing there. Large numbers of the different stages of the flies were collected and two species of Tabanidae viz., *Tabanus macer* and an undetermined species of *Atylotus* have been recorded. There are new records for the locality.

#### 61. Further Observations on the Species of Coccidia Affecting Dogs and Cats with Particular Reference to a New Coccidium Belonging to the Genus Eimeria

S. RAMMOHAN RAO and M. Y. BHATAVDEKAR, Bombay.

A new species *Eimeria rayii* is described in this paper together with an account of other species of coccidia recorded in Bombay State.

The following coccidia have been listed from cats and dogs :—*Isospora rivolta*, *I. felis*, *I. bigemina*, *Eimeria canis*, and *Eimeria rayii*, with a plea for a study of the pathology and physiology of these parasites.

#### 62. A Note on Little known forms of Taenia (Cyclophyllidea).

S. R. RAO and L. S. HIREGAUDAR, Bombay.

During the course of study of taeniid cestodes of dogs and cats the authors came across a taenia with a single circle of hooks on the rostellum. On further study it was found to be quite indistinguishable from other forms of taenia.

#### 63. Studies on the Life History of Orientobilharzia Dattai (Dutt & Srivastava 1952) n.comb.—a blood-fluke of domestic mammals.

S. C. DUTT and H. D. SRIVASTAVA, Izatnagar.

The authors in 1952 published a preliminary note on the morphology and life history of the parasite (Parasitology, Vol. 42, Nos. 1 & 2, pp. 144-150). The present paper reports results of further studies on its life history.

A large number of the commonly available aquatic snails were examined for natural infection with the parasite but only specimens of *Lymnaea luteola* f. *australis* were found to harbour them. Examination of 3306 specimens of the snail revealed an infection rate of 5 per thousand. In the laboratory experiments miracidia attraction was noticed towards *L. luteola* alone. 501 specimens of the snail were exposed to the miracidia in the laboratory. Of 338 snails that survived the incubation

n period 87.5% became positive for the cercaria. The percentage of infection varied from 15 to 100. Snails of all ages were found to be susceptible to the infection. The incubation period in the molluscan host varied from 15 to 67 days depending on the temperature. The morphology of the egg, miracidium, mother sporocyst, daughter sporocyst and cercaria has been studied in detail. Unemerged cercariae were found to possess a pair of 'escape glands'. The cercariae emerge from the snail host during the morning hours.

Buffaloes, cattle, sheep and goats have been found to act as the natural definitive host of the parasite. 52% of the 85 buffaloes examined post mortem were found to be naturally infected. Buffalo-calves, cattle, sheep, goats, donkeys, pigs, dog, cat, monkey, rabbits, guinea pigs, white rats, white mice and some birds were experimentally administered cercariae of *O. dattai*. All the species excepting the pig, dog, cat, monkey and birds were found to be susceptible to the infection.

#### 4. Biological studies on *Orientobilharzia dattai* (Dutt & Srivastava, 1952)—a blood fluke of domestic mammals.

S. C. DUTT and SRIVASTAVA, Izatnagar.

The paper reports the results of studies on the following aspects of the biology of *O. dattai*. :—(1) Effects of temperature and humidity on the viability of ova in undiluted faeces, (2) normal hatching time of ova, (3) longevity of the miracidia and cercariae, (4) infectivity of the cercariae in relation to their age, (5) effects of temperature on the incubation period of the parasite in the molluscan host, *L. luteola*, (6) number of cercariae produced by snails exposed to different miracidial densities, (7) factors influencing the emergence of the cercariae from the molluscan host, (8) effects of the parasitism on the molluscan host and (9) frequency of the occurrence of unisexual and bisexual infections in naturally and experimentally infected snails.

The maximum longevity (44 days) of the ova was at 10°C and it gradually decreased with rise in temperature. At 30-32°C 98.8% of the miracidia hatched out within the first hour of incubation. At 10°C the maximum longevity of the miracidia was 28 hours and that of the cercariae 150 hours. Longevity decreased with the rise in temperature. In winter when the maximum longevity of the cercariae was 52 hours, they retained their infectivity upto 45 hours. The incubation period in the molluscan host varied greatly with temperature. At 33°C it was 15 to 27 days whereas at 23°C it varied from 55 to 67 days. *L. luteola* infected with a single miracidium shed on an average 1271 cercariae per day and those infected with 2-4 miracidia shed about 1915 cercariae per day. Emergence of cercariae from the snail host exhibited a marked periodicity—96.1% of the total cercariae output was during the morning hours. The longevity and reproduction of *L. luteola* was adversely affected by infection with *O. dattai*. Both in nature and under laboratory conditions unisexual infection in snails was more frequent than bisexual infection.

#### 65. Toxicity of certain chemicals to the miracidia and cercariae of *Schistosoma indicum* and *Orientobilharzia dattai*.

S. C. DUTT and H. D. SRIVASTAVA, Izatnagar.

The miracidia and cercariae of *S. indicum* and *O. dattai* live a free living life for a period varying from 6 to 30 hours in case of the miracidia and 24 to 52 hours in case of the cercariae depending mostly on temperature. During this period of their life they are vulnerable to direct attack. Generally it would not be practicable and economical to use chemicals for killing the larvae but in parti-



cular isolated areas it may be feasible. The present paper reports experiments to determine the toxicity of; (1) potassium permanganate, (2) washing soda, (3) washing soap, (4) copper sulphate, (5) calcium hydroxide, (6) Paris-green and (7) Gammaxene to the larvae of the two parasites.

Of the chemicals tested, copper sulphate, potassium permanganate, washing soap, calcium hydroxide and Paris green were found to possess good larvicidal properties. Washing soda was effective only in high concentrations and Gammaxene had no lethal action at all.

**66. Studies on the life history of *Moniezia benedeni* (Moniez, 1879), a tapeworm of ruminants.**

K. N. MEHRA and H. D. SRIVASTAVA, Izatnagar.

The paper deals with the life history of *Moniezia benedeni*. Oribatid mites have been found experimentally to act as the intermediate host of this parasite. Developmental larval stages from the onchosphere to the fully mature cysticeroid have been studied in detail. The number of larval stages harboured by a mite has been found to vary from 1 to 8, the average being 2.5. The cysticeroids measure 100—185 microns  $\times$  85—157 microns depending upon the number harboured by the mite. The egg after being ingested by the intermediate host develops to the cysticeroid stage in 6—7 weeks. A clean lamb was successfully infected by administering it infected mites and the cysticeroids obtained from them. On post-mortem examination it was found to harbour a mature specimen of *M. benedeni*. Infected mites were also fed to a piglet, a monkey and a rabbit but with negative results.

**67. Studies on the life history of *Moniezia expansa* (Rud., 1810), a broad tapeworm of ruminants.**

K. N. MEHRA and H. D. SRIVASTAVA, Izatnagar.

The life history of *Moniezia expansa* has been elucidated. Oribatid mites have been found experimentally to serve as the intermediate host of this parasite. Some of these mites have been sent for identification. A survey of the local pastures has revealed that these mites are fairly common. The details of the larval stages upto the cysticeroid stage have been studied. The onchosphere stages recovered from the mites measure 20—30 microns, the maximum size of the vermiform larval stage being 500 microns. The cysticeroids measure 128—142 microns  $\times$  100—110 microns. Cercomere with or without embryonal hooks has been observed in some of the cysticeroids. The egg develops in the body cavity of the mite to the cysticeroid stage in 9—12 weeks. Infected mites and the cysticeroids obtained from the infected mites were fed to clean kids and lambs. The faeces of an infected lamb was found to be positive on the 47th day of infection and on its post-mortem the animal was found to harbour one specimen of *M. expansa*.

**68. A Note on the Pre-cercarial Development of *Pseudodiscus Collinsi* (Cobbold, 1875) Sonsino, 1895.**

C. T. PETER, Izatnagar.

The development of the various intra-molluscan stages in the life-cycle of *Pseudodiscus collinsi* was not known before. While investigating experimentally the adult of some amphistome ova obtained from a local elephant, the pre-cercarial development of *P. collinsi* was worked out completely. The details of it are given in this paper.

The ova of the fluke obtained from the faeces of the elephant are slightly bigger in those from the equine hosts. The miracidia hatch out in 17 days. *Indoplanorbis exustus*, which is the only snail species found to act as its intermediate host, charges cercariae in 34 days after experimental infection. The cercaria is exactly identical to the one previously shown to develop into *P. collinsi* in equines.

#### 9. On Five New Species of Amphistome Cercariae from India.

C. T. PETER and H. D. SRIVASTAVA, Izatnagar.

While examining the locally available fresh-water molluscs for trematode infection, eight species of amphistome cercariae have been encountered, which include three known forms and five new ones. They are: *Cercaria bulimusi*, n.s.p., from *Bulimus pulchellus*; *Cercaria chungathi*, n.sp., and *C. gyraulusi*, n.sp., from *Gyraulus uvexiusculus*; *Cercaria bareilyi*, n.sp., *C. indoplanorbisi*, n.sp., *C. pseudodiscicollinsi* Peter and Srivastava, 1954, and *Cercariae indicae* xxvi Sewell, 1922, from *Indoplanorbis exustus*; *Cercariae indicae* xxix Sewell, 1922, from *Lymnaea luteola* f. *occinea*. Of these, *Cercaria bareilyi* and *C. pseudodiscicollinsi* belong to the "Diplocotylea" group and the rest to the "Pigmentata" group.

The description and differential diagnosis of each of these cercariae and of its asexual parthenitae and metacercarial stages together with a discussion on their relationships to adults are incorporated in this paper.

With the five new forms, a total of 27 species of amphistome cercariae are now known, 17 referable to the "Diplocotylea" group and 10 to the "Pigmentata" group, of which 6 and 8 respectively occur in India.

#### 10. Biological studies on *Schistosoma indicum* Montgomery, 1906,—a common blood-fluke of Indian ungulates.

H. D. SRIVASTAVA and S. C. DUTT, Izatnagar.

Knowledge of the biology of the free living stages of *Schistosoma indicum* is essential for devising rational measures of control. The paper reports the results of studies on the following aspects of the biology; (1) effects of temperature and humidity on the viability of ova in undiluted faeces, (2) normal hatching time of ova, (3) effects of dilution of the medium, temperature and light on the hatching of the ova, (4) longevity of the miracidia and cercariae and (5) frequency of the occurrence of unisexual and bisexual infections in naturally and experimentally infected snails.

The maximum longevity of ova in undiluted faeces stored in a closed vessel at 0°C was 34 days. The duration was 16 days at winter temperature and 5 days at summer temperature. Desiccation was found to be highly detrimental to the ova. At laboratory temperature during the summer 99% of the miracidia hatched out within the first hour of incubation. Optimum hatching took place when the faeces was diluted with 300 times or more their volume of water. Hatching was completely inhibited in saline solution of strengths above 0.8%. Bright illumination accelerated hatching whereas darkness retarded the process. At 10°C the maximum longevity of the miracidia was 30 hours and that of the cercariae was 145 hours. The longevity of the larvae decreased with rise in temperature. In winter the maximum longevity of the miracidia was 22 hours and that of the cercariae was 48 hours. In summer the periods were 12 hours and 30 hours for the miracidia and cercariae respectively. Both in nature and under laboratory conditions the occurrence of unisexual infection in the molluscan host was found to be more frequent than bisexual infection.



**71. Life history of *Schistosoma indicum* Montgomery, 1906,—a common blood-fluke of Indian ungulates.**

H. D. SRIVASTAVA and S. C. DUTT, Izatnagar.

The authors in 1951 published a preliminary note on the life history of *Schistosoma indicum* (Current Science, Vol. 20, No. 10, pp. 273-275). The present paper reports results of further studies on the subject.

Examination of 4642 specimens of the molluscan host, *Indoplanorbis exustus* revealed an infection rate of about 2 per thousand. In the laboratory studies miracidial attraction was noticed towards *I. exustus*, *Gyraulus convexiusculus*, *Lymanea luteola* and *L. acuminata* but development took place in specimens of *I. exustus* alone. Only very young specimens of the snail were found to be susceptible to the infection. The morphology of the egg, miracidium, mother sporocyst, daughter sporocyst and cercaria has been studied in detail. A pair of 'escape glands' were found to be present in unemerged cercariae. The incubation period in the molluscan host varied from 22 to 37 days according to the laboratory temperature. The cercariae emerge from the snail host during the morning hours.

The infection of the definitive hosts occur *per os* or through the skin. The following species of animals were used in experiments to determine their susceptibility to *S. indicum* infection: Goat, sheep, donkey, buffalo, rabbit, guinea pig, white rat, white mouse, grey mouse and monkey. Of these, all except the monkey were found to be susceptible to the infection. One out of 85 buffaloes examined post morem was found to be naturally infected with *S. indicum*.

**72. Studies on the life history of *Ascaris vitulorum* (Goeze, 1782), the large intestinal roundworm of bovines.**

H. D. SRIVASTAVA and K. N. MEHRA, Izatnagar.

Ascariasis is responsible for high mortality among young calves particularly of buffalo. The mode of infection with *A. vitulorum* had not been definitely worked out. The paper deals with the experiments conducted to find out the possibility of prenatal infection in buffalo-calves. Studies on the incidence of the infection and on some factors influencing the development of the ova are also incorporated.

Faecal examination of 29 buff-calves belonging to the local military dairy farm revealed the presence of the infection in six animals. The earliest infection was found in a 26 days old buff-calf. Four buffaloes in advanced stage of pregnancy were fed 1990, 100, 1700 and 1000 embryonated ova of *A. vitulorum* respectively. The four calves born to these buffaloes were found positive for *A. vitulorum*. The earliest infection was noticed in a 7 days old calf. This clearly shows that prenatal infection in calves can take place.

In 0.5%, 1% and 2% formalin, the ova developed to the larval stage. Ova retained their viability when treated with water at 40°C and 50°C but died when treated with 60° and 70°C. Oxygen has been found to be essential for the embryonation of the ova. Ova, when kept in 0.5% and 2% formalin solutions which was deprived of dissolved oxygen, on examination after five weeks showed only markedly retarded development and in only a very small percentage of them.

**73. A Note on *Syringophilus Bipectinatus* (Heller, 1880)—A Quill Mite of Domestic Fowl in India.**

S. RAMMOHAN RAO and L. S. HIREGAUDAR, Bombay.

A record of *Syringophilus bipectinatus*, a quill mite of domestic poultry has been made for the first time in this country.

## SECTION OF AGRICULTURAL SCIENCES.

President :—DR. R. J. KALAMKAR, B.Sc., B.Ag., Ph.D., F.A.Sc.

### Abstracts

#### AGRONOMY

##### **A Short Note on the Growth of Jute (*C. Capsularis*—D 154) with Fertilisers under Water-logged conditions.**

B. C. KUNDU, M. K. MUKHERJEE and G. HALDER, Barrackpore.

Although *capsularis* jute may stand water logged conditions, when the plants are about 5 to 7 weeks old, it has not been possible to grow jute under water logged conditions from the very beginning. In 1951-52 season, due to shortage of experimental area at Chinsurah Farm, some sowing had to be done in a land, which was almost in a puddled condition. Germination was quite satisfactory. From the time of sowing water began to enter the plots due to seepage of water from an adjoining irrigation canal and there was water logging in the field till the time of harvest.

The sowing was done on the 5th June, 1951 in randomised block lay out with replications and harvested on the 15th Sept. 1951. Fertilisers were added before sowing. The treatments included 6 levels of nitrogen (0, 40, 80, 160, 240 and 320 lbs. N/acre), 2 levels of potash (0, 40 lbs. K/acre) and 2 levels of phosphates (0 and 40 lbs. P/acre). Potash and phosphates were added in combinations only with 240 and 320 lbs. N/acre. There was no appreciable difference in the time of flowering. There was no lodging of plants.

It has been seen that after 75 days of growth, the height and also the final base diameter, green weight, wood weight, bark weight, fibre weight show significant differences due to fertilisers. Application of nitrogen alone beyond a dose of 80 lbs. has not given proportional increase, rather it has depressed yield in many cases. Application of phosphates along with nitrogen and potash have been very much useful, whilst potash has not given any marked effect.

##### **2. Comparative Study on the Yield Performances on the Different Fibre Crops.**

B. C. KUNDU, A. N. DATTA and P. SANYAL, Barrackpore.

A comparative yield trial with jute (*Corchorus capsularis* and *C. olitorius*), Roselle (*Hibiscus sabdariffa* L.), Mesta (*H. cannabinus* L.) and Sunn-hemp (*Crotalaria juncea* L.) was conducted in replicated randomized blocks for 3 years to study the comparative merits of these fibre crops with regard to yield of fibre, rate of growth, flowering and fibre percentages. The data were subjected to serial analysis.

Roselle, Green-pigmented type has given significantly the highest yield of fibre than all the other fibre crops. Roselle (Green and green-pigmented) and jute (C.G. and D154) have given significantly higher yield of fibre than both mesta and sunn-hemp. Although mesta has given higher yield of more than 2 maunds of fibre per acre than sunn-hemp, the difference in yield of fibre is not statistically significant.

A higher percentage rate of growth in height was observed in the early vegetative stage of 42 days growth in all the fibre crops. Sunn-hemp showed the highest rate of growth, while mesta and jute (both C.G. and D154) showed lesser rate and roselle (both green and green-pigmented), the slowest rate. After



140 days from sowing the vegetative growth ceased in all the fibre crops excepting roselle which took 196 days.

In sunn-hemp, mesta and jute, 50 per cent flowering occurred in September with the advent of short-days irrespective of sowings between April and June, while in roselle 50 per cent flowering occurred in November. The flowering of roselle in November indicated that the temperature and light conditions prevailing in this month seem to be favourable for the initiation of flowering.

The fibre percentage with respect to green weight has indicated that jute (C.G. 5.08%) has got the highest percentage of fibre and is closely followed by roselle (Green-pigmented type 4.83%) and jute (D154 4.82%). Of the remaining crops, fibre percentage of mesta (4.51%) has been found to be greater than that of roselle (Green 4.43%) and sunn-hemp (2.77%).

### 3. Dual purpose of Growing Jute for Fibre and Seeds.

B. K. KAR and B. K. DESARKAR, Barrackpore.

In continuation with the studies on the physiology of jute seeds, it was found worthwhile to investigate the problem of obtaining good quality of fibre as well as seeds from the same plant. Generally jute is harvested at the early pod stage and fibre and seeds are not obtained from the same plant. Experiments were, therefore, arranged under field conditions in replicated plots. Records were taken of the growth and maturity of the capsules in *Capsularis* varieties—Fanduk and D154 and in *Oltorius* varieties—Chinsura Green and 040-632. Three harvests were made coinciding with three growth stages of the capsule (which could be visually identified) as :—

(1) Fully developed but green, (2) Capsules—the colour of which was turning brown and (3) Fully matured dark brown capsules. The harvested plants were divided with two sets, one with intact tops and in the other the tops (about 6" below the bifurcation point) were removed for seed collection. They were retted in water to find out the fibre yield. It was found that the germination capacity of the seeds collected at different stages showed normal percentage of germination in the 2nd and 3rd stages. By removing the tops only a small proportion of the yield in fibre was affected. The corresponding quality-ratio of the fibre also varied within the desirable range. It was concluded that both seeds and fibre could be obtained from the same plant by judicious selection of the harvesting time of the different varieties and removing the tops for seed collection.

### 4. Effect of sowing date on Shrivelling of Wheat grains in Cultivator's fields.

S. N. BHARDWAJ, Agra.

Shrivelling of wheat grains is a common phenomenon in 'dry' regions, such as the neighbourhood of Agra. Shrivelling in such localities seems to be caused by adverse weather conditions, i.e. warm dry westerly winds, during the maturity of the crop (March and April). Earliness or lateness in maturity can be influenced by sowing date, but quantitative observations on the amount of shrivelling in different sowing dates do not seem to be available, particularly from cultivator's crops.

During rabi 1952-53, fifty plants each were collected at random from two adjacent cultivator's fields of wheat C.591, sown on 27th October and 20th November respectively. The crops were fairly uniform, and free from rust disease. Manuring and irrigation were similar to both the fields. The plants were collected a week before harvest i.e. in the third week of March. Detailed observations on the height of the main shoot, length of the ear, number of mature and immature

lers, and yield of normal and shrivelled grains were recorded. The data has been analysed statistically.

The late sown plants were taller by 25% (significant), and the ears of the main root were longer by 19% (significant). However, the number of mature and immature tillers was more or less the same from the two sowings. The total yield of the grain per plant was about 8% higher in the late sowing (non-significant), but the grain number was 37% more (significant). This clearly shows the savings of the average grain in the early sowing.

Comparing the grain from main and tiller ears of both the sowings, shrivelling was more pronounced in the tiller ears. The maturity of the late sown main compared to that of early sown was defective as indicated by 1,000 grain-weight (26.8 gms. and 35.6 gms. respectively); the values for tiller ears (22.7 gms. and 23.8 gms. respectively) do not show any difference. Apparently the main ears of the early sown plants matured earlier under more favourable weather conditions, while the tiller ears matured with the main and tiller ears of the late sowing.

The late sown crop, in general was more vigorous but the total yield of the grain was really not higher; at the same time, shrivelling was more pronounced in the main ear; also the average 1,000 grain-weight of the late sown crop (24.9 gms.) was lower than the early sown (31.2 gms.) indicating the poor quality of the former yield.

## 5. Effect of Sowing dates on Wheat in Malwa.

SARDARSINGH, Indore.

As a result of the epidemic rust attack on wheat in 1946 and the erratic distribution of rainfall in Malwa, it was desired to find out the optimum period of sowing wheat under rainfed conditions so that by adjustment of sowing date the crop may escape the attack of rust and at the same time give maximum yield. With this objective in view replicated trials were carried out for six years from 1947-48 to 1952-53 with four sowing dates beginning from middle of October with an interval of 15 days except in the last two seasons when these dates began from first of October with an equal interval on account of the early cessation of rains.

From the results it was found that the optimum period for sowing of wheat under Malwa conditions was from middle of October to the end of October.

Since there was no epidemic of rust during the period of trials, the effect of sowing dates to obviate the rust attack on wheat could not be ascertained.

## 6. Effect of Spacing on the Growth and Fruiting of Tomato Var Marglobe Labour.

R. S. ROY, R. K. SINGH and M. F. BARI, Sabour.

The paper deals with a trial studying the effect of three spacings, i.e. 2', 3' and 4' between plants and 4' between rows on the yield and its components of tomato var Marglobe Labour. This trial was conducted in the vegetable plot of Horticulture Section, Sabour for four consecutive years, i.e. from 1949-50 to 1952-53.

A study of results obtained in the last four years reveals that 4' x 2' spacing produced highest yield per acre, minimum yield per plant, minimum number of fruits per plant and the lightest fruits. On the other hand, 4' x 4' spacing produced maximum weight per fruit and maximum number of fruits per plant but minimum yield per acre. There have been slight variations in the results of two wider spacings from year to year but 4' x 2' has always maintained its superiority over them for producing highest yield per acre.



Considering the economic view point, 4'x2' spacing in tomato seems most practical and profitable as it has increased the yield tremendously without appreciably deteriorating the quality of fruits, growth of plants and facility in cultural operations. Hence it can be safely recommended for use in those places where climate and soil conditions are similar to Sabour.

**7. Fertilizer use of ammonium chloride and ammonium sulphate-nitrate (leunasalpeter) as sources of nitrogen to paddy and wheat.**

S. P. RAYCHAUDHURI and A. B. GHOSH, New Delhi.

Ammonium chloride is used in Japan as a source of nitrogen to paddy and the use of ammonium sulphate-nitrate (leunasalpeter) is known in Western countries. Both carry 26% N of which about 7% is in nitrate form in the latter. Ammonium chloride can be a cheap source of nitrogen by utilising by-product chlorine of industry. Ammonium nitrate (34% N) has hygroscopic and hazardous characters but when mixed equally with ammon. sulphate, the product, leunasalpeter, has quite agreeable properties. Ammonium chloride is not affected by sulphur shortage and in leunasalpeter a 50% saving of sulphur is effected.

In field experiments at I.A.R.I., both ammon. chloride and leunasalpeter were found to be excellent sources of nitrogen for paddy and wheat giving highly significant increases in yield over no manure and were fully comparable to sulphate of ammonia on equal N basis. At 20 lb. N per acre they increased the paddy yield over no manure by 19.4% and 12.7% compared to 21.5% with ammon. sulphate, the increases in yield per lb. of N being 24.8, 16.1 and 27.4 pounds respectively. At 20 and 40 lb. N doses to wheat, ammon. chloride and leunasalpeter gave 43.8% and 38.6% extra grain over no manure, compared to 39.4% with ammon. sulphate, the responses per lb. of N being 20.3, 17.9 and 18.3 pounds respectively. 40 lb. N dose had same effect as the 20 lb. one. The fertilizers did not have any appreciable effect on nitrogen percentage of the produce but nitrogen recovery significantly increased with their application.

**8. Investigations into the effect of green manuring of cotton and its residual effect on subsequent crop of grain juar.**

R. J. KALAMKAR and L. B. DESHPANDE, Nagpur.

A green manuring experiment on cotton was laid out in the year 1952-53 at the Government Experimental Farm, Nagpur, in which the green manure crops grown in between the cotton lines were sann hemp and Urid both with and without the application of  $P_2O_5$  at the rate of 20 lbs. of  $P_2O_5$  per acre. Cotton and the green manure crops were sown the same day. The other treatments included against the control were Farm Yard Manure at the rate of 10 cart loads per acre and Ammonium Sulphate drilled with the seed and Ammonium Sulphate top dressed at the rate of 20 lbs. of Nitrogen. Two spacings viz., 18" and 24" in between cotton lines were also included. Green manuring in situ was done on half the plots 30 days after sowing and on the other half, after 40 days of sowing. No significant effect was observed between the green matter added in the presence and in absence of  $P_2O_5$ . 6.7 tons and 10.0 tons of green matter per acre were added through sann in 18" spacing by 30 and 40 days growth respectively, while for Urid, the quantities worked out 6¼ tons and 8.3 tons respectively. For 24" spacing the green matter added through sann hemp was 4.9 and 7.5 tons per acre respectively for 30 and 40 days growth as against 3.5 and 6.5 tons of green matter through Urid.

The statistical analysis of the kapas yields did not indicate any significant difference due to the various treatments tried on cotton. The mean yield of kapas per acre worked out to 2733 lbs. per acre.

In 1953-54, the experiment was slightly modified. The analysis of kapas yields for this year also indicated that there was no significant difference in the yield of kapas due to the various treatments.

*Residual effect on juar.*—The data of the juar yields following the cotton green manuring experiment in 1952-53 have been analysed. The important conclusions are:—

- (1) Spacing has not given significant residual effects on juar.
- (2) All the treatments, viz., Sann, Farm Yard Manure and Ammonium Sulphate have shown residual effect on the following juar crop but the plot green manured with Sann alone has shown the residual effect to be significant. The highest yield of 4109 lbs. per acre of grain juar was obtained from the plot which was in the previous year green manured with sann as against 3635 lbs. per acre of grain juar obtained from the control.
- (3) Residual effect of previous application of phosphate to a green manure crop on the yield of juar is absent.

Further work is in progress.

#### 1. Investigation into the effect of sowing Deshi and American cottons successively and in rotation with each other with and without manuring.

R. J. KALAMKAR and S. G. KOLTE, Nagpur.

An experiment has been laid out in 1952-53 to study the effect of a Deshi variety, H.420 and an American variety, Buri O394 cotton grown successively in rotation with each other with and without manuring. The manuring consists of 50 lbs. of Nitrogen per acre in the form of groundnut cake at the time of sowing. The previous crop was groundnut. It is only in 1953-54 that the first data under complete treatments is available.

The results of the trial indicate that

(1) The rotational effect is significant. Cotton crop either of Deshi H.420 or American Buri O394 following a previous crop of Deshi H.420 yields significantly less than that following a previous crop of American Buri O394. As against an average yield of kapas of 288 lbs. per acre, after H.420, that after Buri O394 was as high as 538 lbs. The highest yield of 690 lbs. per acre was obtained from H.420 after Buri O394, while the next higher was 386 lbs. per acre given by Buri O394 after Buri O394. The lowest yield was of 202 lbs. per acre of Buri O394 after the previous crop of H.420.

(2) H.420 Deshi has given higher yield than Buri O394.

(3) Manuring results in increased yields and the effect is significant only in the case of Buri O394 following a previous crop of Buri O394.

(4) Interaction between manure and rotation is insignificant.

Root studies of the two types of cotton conducted reveal that:

(a) Roots of H.420 are longer and stronger than those of Buri O394.

(b) Maximum length of root of H.420 was 8 feet while that of Buri O394 it was 5½ feet.

(c) H.420 cotton has sparse tertiary roots, while Buri O394 cotton has a large number of tertiary roots.

(d) Lateral expansion of roots in the case of Buri O394 cotton is more, nearly 5' to 6', while that in H.420 is less, being nearly 3' to 4'.

(e) In the case of H.420 cotton, maximum roots are found upto the depth of 5' while in the case of Buri O394 they are found upto the depth of 3'.



**10. Jute leaves as manures : I : Influence on the growth of paddy.**

M. K. MUKHERJEE, S. C. CHAKRAVORTY, A. K. KUNDU and G. HALDER  
Barrackpore.

Considerable number of leaves fall during the growth of jute. These leaves also fix some nitrogen. The yield of winter (Aman) paddy is not depressed due to growing of jute as a preceding crop due to leaf fall. In the present paper data on the manurial effect of jute leaves are presented. Addition of jute leaves has increased the weight of the plant, straw, filled grain, chaff, no. of tillers, earheads and grains markedly, whilst the length of earheads has not increased significantly. 0.58 gms. of nitrogen has been added per plant from the jute leaves. The increase in grain yield has been of the order of 10 gms., this is much more than what may be expected from Yates formula, and more so if it be considered that the leached water has not been accounted for. This also indirectly shows that some nitrogen has been fixed. It is, therefore, desirable to return to the soil all the leaves before the plants are steeped in the manner suggested by Kundu and Mukherjee (1954).

**11. Manuring of Paddy in Malwa.**

SARDARSINGH, Indore.

Malwa although does not fall under the category of main rice growing tracts having mostly rainfed area still the cultivators do grow paddy either in low lying areas or wherever little irrigation facilities exist. As such Japanese method of paddy cultivation which has contributed a great deal to increase the yield would not be so much popular except in well protected irrigated areas. As a result of low yields of this crop in this tract it was felt of paramount importance to find an optimum dose of a suitable manure to enhance the yield. For this purpose an experiment was laid out with two manures namely Ammonium Sulphate and Groundnut Cake in varying doses of nitrogen per acre with and without the combination of different doses of Superphosphate. In the first year of the trial the manures were tried on Barwani 22—a local strain while in the second year Basmati—a fine strain was used.

In both the seasons, application of Superphosphate slightly depressed the yield with increased doses. On the other hand the higher doses of nitrogen gave higher yield of paddy but it was significantly higher with 40 and 60 lbs. N per acre over control.

In the first year, the two manures showed an identical response while in the second year Ammonium Sulphate proved significantly superior to groundnut cake.

The economics of manuring have also been studied for the two varieties in each year.

**12. Patterns of flowering in the improved rice varieties of Hyderabad.**

M. S. POWAR, P. NARAHARI and V. V. SURYANAVAYANA MURTY,  
Hyderabad.

Fourteen improved rice varieties of Hyderabad belonging to Early, Intermediate, Late and Very Late maturing groups were studied at Himayatsagar Hyderabad, from March 1951 to September 1953, for the pattern of their flowering by sowing at monthly intervals. The results bring out three distinct patterns of flowering in these varieties. When sown in February and August, the Early Intermediate groups of varieties flower in a minimal period. In the April and October sowings, these groups require maximal periods. In the case of Late

February and October sowings take the longest time to flower, while the January and August sowings take the minimal time. The Very Late group, sown in January and October, requires the longest period to flower while the August and December sowings take the least time.

The main flowering period of all the HR varieties extends from the second week of September to the middle of November. The other flowering period for these varieties falls between the second week of March and third week of April. The Early and Intermediate varieties are period-bound and the Lates and Very Lates are season-bound, corresponding to the Aman paddies of Bengal.

### 3. "Study of double cropped area in some districts of U.P."

A. P. BHATTACHARYA, Roorkee.

A study was carried out regarding double cropped area for the districts of Banaras, Meerut and Jhansi in U.P., double cropped area including crops like gram, pulses, peas, mustard, etc. plus area under sugarcane. The factors which were thought to affect the double cropped areas were studied in the analysis. They were taken to be actual late monsoon rainfall (from the 1st September to the 31st October), normal winter rainfall (from the 1st November to the 31st March), available cultivable land per head and the weighted general index number of wholesale agricultural prices. The period under consideration was from 1921-22 to 1951-52.

It was found that for Banaras and Meerut Districts, which are typical of eastern and western U.P. respectively, double cropped area is significantly affected by cultivable land available per head, the more so for Banaras District. The less the available cultivable land per head the higher is the double cropped area. For Banaras District, the double cropped area is also affected by normal winter rainfall. For Meerut District, the double cropping is affected by actual late monsoon rainfall. For Jhansi, the effect of cultivable land available per head is insignificant, whereas that of normal winter rainfall is significant.

## AGRICULTURAL CHEMISTRY & SOIL SCIENCE

### 4. A simple and cheap remedy to increase the low Fertility of Indian soils.

N. V. JOSHI and S. G. JOSHI, Poona.

A comparison of the average yields of crops per acre in different countries show that the average yields of crops per acre in India are the lowest in the world.

A systematic investigation of the soils giving low crop yields in Maharashtra and Konkan regions showed that their productiveness could not be sufficiently increased and brought up to the level of the highly productive soils by mere addition of nitrogenous manures. Addition of trace elements or micronutrients along with the nitrogenous manures was necessary to restore their productiveness to the expected level. Among the trace-elements, the addition of copper in the form of copper sulphate gave the highest increase in yields in pot culture experiments. Cultivators were therefore requested to try the addition of copper sulphate along with their usual manurial treatments. The results of the field experiments proved that an increase of 35 to 80% in yield over the control was obtained by the addition of copper sulphate to the soils along with the usual manurial treatment. The variation in percentage increase of yields depends on the kind of soil in which the crops were grown.

It is inferred from these experiments that the crops usually grown in such soils are unable to utilize to the full extent the major plant nutrients, Nitrogen,



$P_2O_5$  and  $K_2O$  in the added manures and those already present in the soils, unless the deficiency of trace-elements in this particular instance, copper—is made up. In other words it is considered that copper is the limiting factor for crop production in many poor soils in India in general and in Maharashtra and Konkan region of the Bombay State in particular and further that the crops grown in such soils, though not showing visible signs of any known disease are still suffering from what may be called 'Copper anaemia'.

The results of our investigation indicate that many cultivable waste lands are probably deficient in some trace-element or another, and therefore, they fail to give economic crop yields. It is suggested that if a proper investigation of these cultivable waste lands which are spread far and wide throughout India, is carried out, we might be able to detect the deficiency in trace elements of these different lands and then their fertility could be restored by the addition of the particular deficient trace element along with the other major manurial ingredients and they will thus be reclaimed and brought under cultivation so as to give economic returns in increased crop yields.

### 15. Boron requirements of some Bihar Soils.

S. C. MANDAL, M. A. ALI and H. N. MUKERJEE, Sabour.

Boron status of a number of Bihar soils was determined. The total boron content varied from 18.0 to 83.0 p.p.m. and the water soluble boron varied from 0.3 to 2.0 p.p.m. The boron fixing capacity of the soils ranged from 6.5 for sand loams to 10.3 mgms. per kgm. for loams. Islampur soil which contained the lowest amount of water soluble boron responded to borax manuring at 20 lbs. per acre. An increase of 100% in the yields of potato and maize was obtained as a result of boron application to this soil. But application of borax for two successive seasons or at a higher rate (40 lbs. per acre) led to boron toxicity. Some crops readily responded to borax at Islampur. They may be called borophilic crops. Some crops, on the other hand were more susceptible to boron injury than others. They are borophobic crops. Crops in decreased orders of borophilism are pea, barley, maize, potato, and *kalai*. The descending order of borophobic crops would be *kalai*, gram, onion, tobacco, lady's finger and rice. Wheat was found to be the least responsive to boron and also the most resistant to boron injury of all these crops.

Boron toxicity symptoms were reflected differently in different crops. Marginal scorching and yellowing of the remaining portion of the leaf is the common boron toxicity symptom of pea, *kalai* and soybean. Gram has a tricoloured pattern. Black necrotic spots are produced in the leaves of the rice plant whereas barley leaves are affected with dark streaks arranged longitudinally.

A 20 lbs. per acre application of borax to Sabour soil containing 2.0 p.p.m. of water soluble boron caused boron toxicity to maize, potato, onion, lady's finger and *kalai* crops. Normally plants at Islampur contained 30 to 50 p.p.m. while at Sabour they contained 80 to 100 p.p.m. of boron. Groundnut on a Jalalgarh sand loam soil, having 0.6 p.p.m. of soluble boron responded to borax manuring. Bihar soils containing higher amounts of boron did not respond to borax. Thus it seems that soils containing more than 0.6 p.p.m. of water soluble boron are not likely to require any application of boracic fertilizers for normal crop growth.

### 16. Comparative value of some rapid soil testing methods for assessing the available status of Nitrogen and Phosphate in Red and Laterite Soils.

S. P. RAYCHAUDHURI, B. V. SUBBIAH and M. P. SINHA, New Delhi.

Due to the failure of conventional methods to adequately assess the manurial needs of crops, rapid soil testing methods empirically correlated for their suitability

h crop responses, are finding extensive use for assessing the available nutrient status. In the present study, some rapid soil testing procedures for nitrogen and phosphate have been examined for their suitability in red and laterite areas by finding their relative correlations with crop made responses to the applications of nitrogenous and phosphatic fertilisers.

The results indicated that amongst the methods tried for nitrogen, (1) total nitrogen, (2) Mineralisable nitrogen obtained by incubation, (3) available nitrogen obtained by hydrolysis with sulphuric acid (8N), (4) alkaline permanganate extractable nitrogen, the available nitrogen obtained by alkaline permanganate (0.32%  $\text{K}_2\text{Cr}_2\text{O}_7$  with 2.5% alkali) and mineralisable nitrogen gave the best correlation with crop responses for phosphate, amongst the following methods (1) Troug's method using N/500 sulphuric acid buffered to pH 3 with ammonium sulphate,

Bray's method using 0.03N ammonium fluoride in 0.1N HCl, (3) Olson's method using sodium carbonate adjusted to pH 8.5, (4) Spurway's method using 0.135 N HCl, (5) Beater's method using 0.048 N sulphuric acid buffered to pH 1.5 with sodium borate, (6) Jacquet and LeNir's method using 0.25% trichloroacetic acid, (7) Morgan's method using sodium acetate and acetic acid buffered to pH 4.8 with acetic acid, only Troug's method correlated with crop responses at 1% level while Bray's method and Jacquet and Lenir's method were correlated at 5% level.

From the point of view of rapidity of estimation, the alkaline permanganate method of estimating the available nitrogen and all the phosphate methods were provided a colorimetric method is adopted for the phosphate estimation.

These results clearly indicate that the rapid soil testing procedures have a definite diagnostic value in spite of the fact that there are numerous fluctuating factors which influence the crop growth.

#### **7. Effect of continuous growing of the same crop and rotational system of cropping on soil fertility.**

(KUMARI) V. S. LAD and D. K. PATEL, Poona.

An experiment, to study the effect on soil conditions of continuous growing of the same crop (Jowar, Cotton, Sann and Groundnut) and following every year under irrigation, was started in 1934 at Pategaon. In 1944, additional plots, for comparison with rotational system of cropping as sann-jowar, cotton, groundnut-jowar grown in two years, were started. The analysis of soil samples, taken upto 100 cm depth from different plots, indicate as under.

Continuous growing of the same crop as well as rotational system of cropping do not produce any appreciable change in the soil reaction as well as the free lime content of soil. Fallows and growing of sann have improved nitrogen content of soil. Sann-jowar one year and cotton-groundnut two year rotation seem to be beneficial in improving the nitrogen status of soil. Rotational cropping definitely improves the humus status of the soil and increases the organic carbon content as well as availability of phosphate in the soil, a two year rotation of jowar-cotton being the best in these respects compared to other rotations. The availability of potash is decreased under continuous growing of the same crop as well as rotational system of cropping, the depletion being the least with jowar-cotton rotation. A slight increase in exchangeable calcium is observed with rotational cropping.

#### **18. Effect of growing cotton in rotation with different crops on structure of black cotton soil.**

T. L. DESHPANDE, D. K. BALLAL and R. J. KALAMKAR, Nagpur.

An experiment on growing cotton in rotation with different crops has been in progress since 1923 at the Experimental Farm, Akola, Madhya Pradesh. The soil at this station is typical of the black cotton soils of Berar.



Plots under the following treatments were studied with a view to evaluate the changes in soil aggregation brought about by different rotations followed continuously for the last 30 years.

- (1) Cotton year after year.
- (2) Cotton followed by juar alternately.
- (3) Three course rotation : Cotton-Juar-Groundnut.

Soil structure was evaluated by studying the following properties :—

- (1) Water stable aggregates.
- (2) Total pore space.
- (3) Volume of large pores.
- (4) Volume weight.
- (5) Dispersion coefficient.
- (6) Rate of percolation of undistributed core samples.
- (7) Rate of percolation of disturbed soil samples.

It has been observed that in spite of the fact that these rotation have been in progress for the last 30 years, none of the properties studied indicates any significant change in the structural condition of the soil.

The results are discussed in detail in the paper.

## 19. Fertilizer value of Dicalcium phosphate in non-acid and calcareous soils of India.

M. A. IDNANI, A. B. GHOSH, R. K. CHIBBER and M. B. SENGUPTA,  
New Delhi.

Dicalcium phosphate contains citrate-soluble  $P_2O_5$ , which is available to plants, with the advantage that the phosphate, unlike in superphosphate, being water-insoluble, is less readily fixed in acidic and calcareous soils. The material containing 34%  $P_2O_5$ , prepared at N.C.L., Poona, from rock phosphate and hydrochloric acid, is a white powder with excellent physical conditions. It was received through the ICAR and field experiments were started in 1952 on non-acid soil (pH 7.4) at Delhi and calcareous soil (36%  $CaCO_3$ ) at Pusa (Bihar). The fertilizer tested against superphosphate and bonemeal, all the three applied at 80 lb.  $P_2O_5$  per acre along with ammonium sulphate at 40 lb. N and farmyard manure at 80 lb. N per acre.

The results of the two years' trials showed that in Delhi soil dicalcium phosphate applied with ammon. sulphate to paddy increased the yield by 32% over N alone as against 24% with superphosphate and 12% with bonemeal. Over FYM dressing, the respective responses were 52.6, 26.3 and 21.2 per cent. In trials on wheat at Pusa, dicalcium phosphate applied with ammonium sulphate gave 113% additional yield over N alone compared to 133% with superphosphate. FYM alone had given high crop yields and the additional response with dicalcium phosphate and superphosphate were 45% and 49% respectively. Bonemeal in either case had no significant effect.

Dicalcium phosphate, in the above trials, has been found to be as good a phosphatic fertilizer as superphosphate and superior to bonemeal. Further trials are in progress.

## 20. Manganese Status of Soils of Western India—I.

J. V. AMIN and C. C. SHAH, Anand.

Manganese is known to be present in soil in quantities varying from 0.001 to 1.3 p.c. To obtain a true picture of the status of manganese in a soil, it is necessary to determine all forms of manganese. In the present paper twelve typical soils from Western India were analysed in detail for the various fractions of manganese.

They were found to contain 0.03 to 0.12 p.c. total manganese and more than 20 p.p.m. of available manganese. Those rich in total manganese are also rich in active oxides of manganese. The readily soluble manganese in 60 different soils were determined and it was found to vary from 16-260 p.p.m. The results obtained indicate that manganese deficiency is not likely to occur in soils of this tract.

### 1. Manganese Status of Soils of Western India—II. Content of Manganese in Plant Leaves.

J. V. AMIN and C. C. SHAH, Anand.

Manganese content in the mature leaves of 73 different crops and plants growing in Western India has been determined. It has been found that it varies appreciably from 30-148 p.p.m. As a rule grasses and cereals contain small amounts and leguminous plants large amounts. A comparison of figures with those published shows that there is little likelihood of crops suffering from either deficiency or excess of manganese in Western India.

### 2. Potash needs of Bihar soils.

H. N. MUKHERJEE, S. C. MANDAL, and B. D. MUKHERJEE, Sabour.

It is widely believed that Indian soils do not need potash manuring. Extensive simple experiments on cultivators' fields in Bihar during the last five years have shown that potash can increase crop yields, when used in conjunction with nitrogen and phosphates, from 1-4 maunds per acre or more in most soils of the State. Being a cheap fertiliser, its use becomes very economical. It was therefore attempted to find out, whether the potash needs of individual soils may be determined by quick chemical tests.

Hydrochloric acid soluble K, citric acid soluble K and exchangeable K were determined in 26 typical Bihar soils, but no relationship between the different values could be obtained. Analysis of soils, from field trials with potash, showed that the amounts of 'total', citric soluble and exchangeable K did not correlate with the field K responses. While soils with 300-775 lbs. of exchangeable K showed field response to K, soils with less than 250 lbs. exchangeable K did not show any response.

An interesting relationship with field response was however noticeable with the potash saturation of the exchange complex and the 10 soils studied show that if the K-saturation is below 5 per cent., a field response to potash manuring is obtained. A soil having 300 lbs. exchangeable K but 2.7 per cent K-saturation gave 4.3 maunds of extra yield due to K-manuring, but another soil having the same amount of exchangeable K but 5.8 per cent K-saturation showed no response.

A larger number of soils are being further tested to confirm this finding.

### 23. Rape (*Brassica napus* Linn). bhoosa as food for cattle.

K. SAHAI, I. KUMAR and N. D. KEHAR, Izatnagar, U. P.

The rape seed plant is extensively grown in many parts of India. During the extraction of seeds, the stem and husk remain as byproducts and are not economically utilised. The farmers generally use the dry plant as fuel. Investigations were carried out to determine the nutritive value of rape bhoosa as fodder for cattle.

On chemical analysis, rape bhoosa was found to contain 5.94 per cent crude protein, 0.98 per cent extract, 50.57 per cent crude fibre, 34.77 per cent nitrogen-free-extract, 1.93 per cent lime (CaO) and 0.48 per cent phosphorus ( $P_2O_5$ ).



To determine the nutritive value, the bhoosa was fed to four Kumauni bullocks. The ration in each case consisted of rape bhoosa fed *ad lib.* supplemented with requisite amount of linseed cake to meet the digestible crude protein requirement. The palatability of the husk was found to be satisfactory.

The digestible crude protein, total digestible nutrients and starch equivalent values in lbs. per 100 lb. of rape bhoosa on dry basis were found to be 2.54, 45.54 and 15.95 respectively.

The above observations indicate that as compared to dry roughages like wheat bhoosa and rice straw, rape bhoosa contains appreciably higher amounts of digestible crude protein.

The animals were in positive balance for calcium and phosphorus while the nitrogen balance on an average was slightly negative. The animals, however, maintained their body weight through out the experimental period.

#### **24. Semi-acidulated rock-phosphate (Kotka phosphate) as a phosphatic fertilizer for wheat in calcareous soils.**

A. B. GHOSH, M. B. SENGUPTA and S. P. RAYCHAUDHURI, New Delhi.

Semi-acidulated rock phosphate (kotka phosphate) prepared by mixing finely ground rock phosphate with fresh superphosphate gives twice the amount of fertilizer, mostly as dicalcium phosphate, with the same amount of sulphuric acid. The material received through the ICAR, containing 14 per cent citrate-soluble (available)  $P_2O_5$ , was tried on wheat during 1953-54 on the calcareous soils (36 per cent  $CaCO_3$ ) at Pusa (Bihar). The fertilizer which was tested against superphosphate, was applied both by broadcast and placement at 80 lb.  $P_2O_5$  per acre. The soil being deficient in nitrogen, phosphates were applied over a dressing of oilcakes at 40 lb.N per acre.

Broadcast application of fertilizers had no effect on the yield of wheat. In calcareous soils the fixation of phosphate is rapid and surface application is often likely to be ineffective. But in placement application, both kotka phosphate and superphosphate gave highly significant increase in yield over oilcakes alone, the respective percentage increases being 54.2 and 35.9. Kotka phosphate produced 2.13 Mds. of extra grain per acre over no phosphate treatment compared to 1.41 Mds. by superphosphate, but this difference was not statistically significant.

The results showed that kotka phosphate is a good source of  $P_2O_5$  to wheat in calcareous soil. In addition to its cheaper production, there is another advantage that the phosphate applied in citrate-soluble form is likely to be less readily reverted than that in water-soluble superphosphate.

Further experimentations are in progress.

#### **25. Soils of Simla Hills.**

S. J. LOTE, and R. V. TAMHANE, New Delhi.

The present investigations deal with the Simla Hill Soils. The study of the mountain soils in general is difficult owing to their in-accessibility and steep gradient. However, the knowledge of soil formation in the mountainous region which constitutes the upper catchment areas of the rivers is essential for flood control. The paper deals with the effects of topography, vegetation and climate on the pedogenic processes at an elevation of 7224 feet, in the Simla region.

Owing to the hilly and strongly rolling topography the profiles are channery and have diffuse boundaries between the genetic horizons; thus indicating their skeletal nature and juvenility. The sigmoid nature of the mechanical composition curves, an insignificant variation in the chemical composition of solum and the parent rock, the lack of differential elluviation of  $SiO_2$  and  $R_2O_3$ , low degrees of

athering and the analytical results of the Tamm's leachate corroborate the maturity of the soils and the predominance of the mechanical disintegration of the parent rocks over the chemical weathering.

The needles of the conifers growing on these soils show high base status and cation content in their ash. This feature of the vegetation seems to be the reason for the development of a mull horizon in the profiles of the forested region around Simla, though mor is a common occurrence under the coniferous vegetation. There is also the predominance of exchangeable calcium amongst the exchangeable cations in the surface soils though the parent material contains more magnesium than calcium and the top-soils are slightly acidic and desaturated. The high level of leaching of the bases through the plants, the fallen plant residues, soil and the plants again, can be taken to be responsible for the above findings. This role of the vegetation also accounts for the stability of clay complex which maintains the  $\text{SiO}_2/\text{R}_2\text{O}_3$  ratio at a level of 2:2. It checks development of podzolisation which is evident from the clay analysis and curves representing the analytical result of Tamm's leachate.

The C:N ratio varies from 6.13 to 32.09 from the sub-soils upwards. For these wide variations in the C:N ratios, climatic elements such as wide fluctuations between the day and night temperatures at such an elevation and the cold period when the samples were taken and the droughty soil climate due to good internal drainage, light texture and steep gradient, appear to be responsible. Such a climate is not favourable to maintain microbial activity at a high level for decomposing plant residues specially in cold seasons.

In general, these soils are channery and immature and show wide fluctuations in C:N ratio. Similarly less advanced chemical weathering and stability of the colloidal complex due to enough of exchangeable calcium in the clay complex in spite of the coniferous forest, appear to indicate that Simla soils have some features common to the brown forest soils and yet have some dissimilarities. Hence, they can be classified separately under a provisional class as "Himalayan Humus soils".

## 6. Studies on Ammonification and Nitrification in Bihar soils in relation to soil conditions.

K. K. JHA, A. S. VARMA, R. SINGH and H. N. MUKHERJEE, Sabour.

Ammonium sulphate and oil cakes are extensively used for manurial purposes in Bihar. But very little knowledge exists on the nature and extent of available nitrogen, that may be formed as a result of such manuring in Bihar Soils. Hence an investigation was started to find out the ammonification and nitrification of these fertilisers under the varying soil conditions of Bihar. Ammonium sulphate and linseed cake were incubated at room temperature with 18 soil samples from different parts of the state under optimum conditions and ammonia and nitrates determined.

The results of these investigations suggested that there is a fair degree of reciprocal correlation between the pH of the soil and the accumulation of ammonia from linseed cake. Islampur soil with a pH of 5.2 was found to accumulate 434 p.p.m. of  $\text{NH}_3\text{-N}$  and Muzaffarpur soil with a pH of 7.6 contained only 63 p.p.m. In new alluvial soils of North Bihar (pH 5.2—7.6) there is less accumulation of  $\text{NH}_3\text{-N}$  (average 161 p.p.m.) than in older soils of south Bihar (average 201 p.p.m.). Chota Nagpur soils (pH 5.2—6.6) retain even higher amounts of  $\text{NH}_3\text{-N}$  (average 80 p.p.m.). There is higher accumulation of  $\text{NH}_3\text{-N}$  in lowlands (average 210 p.p.m.) than in uplands (average 164 p.p.m.).

Nitrification of ammonium sulphate is poor in six soils with pH values between 5.2 and 6.4 (average 126 p.p.m.) of  $\text{NO}_3\text{-N}$  but at the same pH, the nitrification of



linseed cake is more efficient (average 324 p.p.m.). This unexpected result found in six soils is being further investigated. At higher pH nitrification of ammonium sulphate as usual is higher (210 p.p.m.) of  $\text{NO}_3\text{-N}$  than the linseed cake (62 p.p.m. of  $\text{NO}_3\text{-N}$ ). Unlike ammonia accumulation nitrification of soil nitrogen is generally higher in uplands than in lowlands.

## 27. Studies on the nitrogen economy and aggregation of an upland soil of South Bihar.

S. C. MANDAL, S. K. DAS, A. B. LAL and H. N. MUKHERJEE, Sabour.

Confirmatory results of past findings, that *kalai* (*Phaseolus mungo*) has a highly beneficial effect on wheat, have been obtained. *Kalai*, grown in *kharif*, was found to enrich the loamy soil of Sabour not so much in total nitrogen as in available nitrogen or nitrates. Of the three legumes studied in this connection it was found that *kalai* donated 60.1 p.p.m., *mung* 35.4 p.p.m. and soybean 24.8 p.p.m. of nitrate nitrogen to the soil and, as a result, the yields of the succeeding crop of wheat were 13.1, 6.4 and 4.6 maunds per acre respectively. It was also found that the best time of sampling the soil for an effective appraisal of its available nitrogen status is the period between one and two months after the sowing of wheat. Sabour soil has a very poor state of aggregation, normally. Several grasses and legumes were grown singly and in combinations on a structurally poor soil. It was found that a *dub* grass and burr clover association growing only for six months could raise the degree of water stable aggregates >0.25 m.m. from 5.8 per cent to 26.3 per cent. The yield of maize succeeding this association was 100 per cent higher than that obtained from the corresponding fallow plots. Eliminating the effects of nitrification brought about by the roots of burr clover it was found that 50% of the increased yield of maize could be accounted for higher state of soil aggregation. In another experiment carried out on the effect of various soil conditioners, synthetic and natural, it was found that "Krillium" produced a very high degree (40%) of water stable aggregates >0.25 m.m., in the soil, and raised the yield of wheat by 20%.

## 28. Influence of phosphorus on nitrogen utilisation by Ragi Crop.

B. V. VENKATA RAO and S. V. GOVINDARAJAN, Bangalore.

The results of four experiments on Ragi (*Eleusine Coracana*) conducted in plots to study the influence of increasing doses of phosphoric acid up to 160 lbs. per acre, on the utilisation of nitrogen supplied at the rate of 40 lbs. per acre, are discussed. The yields of Ragi grain and straw and also the analysis of grain and straw with regard to nitrogen and phosphoric acid contents are recorded. The amounts of these nutrients removed in the crop from an unit area is worked out. It is seen that there are steady increases in crop yields with incremental doses of phosphoric acid up to 80 lbs. level. A tendency towards accumulation of phosphoric acid in the straw at higher levels of application is noticed. The amount of nitrogen removed in the crop is found to improve with increases in doses of applied phosphate and is highest at 160 lbs. levels, the increase being 50 per cent more than when no phosphate has been applied.

## 29. Liquid Ammonia as a Fertilizer—some preliminary soil studies on Nitrogen Transformations.

B. V. VENKATA RAO and S. V. GOVINDARAJAN, Bangalore.

In this paper some preliminary soil studies on the use of liquid ammonia as a fertilizer for crops is reported. The mechanism of injection of liquid ammonia into

soil, the transformation of injected ammonia in the soil and the losses of ammonia occurring at the soil surface are discussed. It is found that ammonia is immediately fixed into the exchange complex but remains in a free state for two to two weeks after injection. The nitrification of ammonia is seen to be more rapid than ammonium sulphate. The losses of ammonia due to escape at the soil surface is found to be less than one per cent of the quantity injected at depth into the soil.

## 1. BIOCHEMISTRY & ORGANIC CHEMISTRY

### A note on the Biochemical changes during retting of Jute.

A. K. KUNDU and G. HALDER, Barrackpore.

Retting is the single most important factor determining the quality of jute. A thorough knowledge of the mechanism of retting is necessary for the improvement of retting technique. Biochemical changes during retting have been studied. It has been found that there are some common features in both the species, *reticularis* and *olitorius*, and the varieties studied. Results of the improved *olitorius* variety, 040-632 have already been reported previously (Kundu et al, 1954). The most salient features may be summarised as follows :

(i) Number of aerobic bacteria is greater at the initial stage and the number of anaerobic bacteria at the latter stage is very high. Number of aerobic bacteria varies directly and the number of anaerobic bacteria varies inversely as the dissolved oxygen.

(ii) The amount of nitrate nitrogen and ammoniacal nitrogen decreases at the initial stage.

(iii) pH after a initial rise begin to fall.

(iv) The amount of dissolved inorganic phosphorus first rises from almost nil and then there is a fall.

There are some varietal and specific differences.

From the data presented, it may be seen that in retting there are two distinct phases—one aerobic and the other anaerobic. In the earlier stages, the changes produced are due to the activity of aerobic bacteria and in the final stage, it is due to anaerobic bacteria. The disappearance of the initial decomposition products suggests that phosphates and nitrogenous materials may reduce the retting period. This has been corroborated by other experiments.

### 1. Microbiological Commensalism in the decomposition of Alpha—Humus.

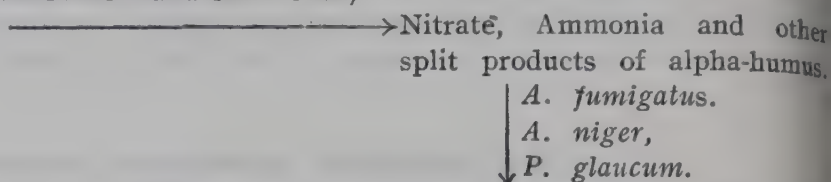
S. K. MAJUMDAR, Mysore.

Though humus represent the most resistant component of soil organic matter decomposition by microbes, yet under natural conditions its depletion from the soil and evolution of ammonia and carbon-di-oxide serve as indices for the decomposition. But direct evidence about the micro-organisms living on humus as source of energy and growth has not been produced so far. In this investigation it has been found that alpha-humus decomposition was due to the activities of bacterial organisms like micrococci and short rods naturally occurring in soil. Species of *Aspergillus* and *Penicillium* were not capable of utilizing alpha-humus, but when these were present along with the micrococci and short rods ; *A. fumigatus*, *A. niger* and *P. glaucum* could grow on only alpha-humus. Silicagel plates with alpha-humus were prepared for these studies.

Both ammonification and nitrification of humus nitrogen were brought about by these bacteria.



It could be concluded that decomposition of alpha-humus was due to commensalistic activities of different groups of organisms. The commensals which have resulted the decomposition of alpha-humous under laboratory conditions, the mode of which can be precisely represented by the following diagrams :—  
Alpha-humus nitrogen (micrococci and short rods)



Further dissimilation products of humus, utilization of simpler nitrogenous substances and synthesis of body protein.

(Commensalism of bacteria and fungi in the decomposition of alpha-humus.)

### 32. Microbiological estimation of Thiamine in wheat.

Y. P. GUPTA and N. B. DAS, New Delhi.

Different varieties of wheat were analysed for their thiamine content by the microbiological method of Sarett and Cheldelin with the help of *L. fermenti* 36. In order to find out the reliability of the method, growth of the bacteria was measured by turbidity as well as by titration after 18 hour's incubation at 37°C. Sterilization was carried out in steam-bath, for 20 minutes.

It is found that the thiamine values obtained by titration are slightly lower than those obtained by turbidity. There is slight variation among the different varieties of wheat analysed here. The range of thiamine values by turbidity and titration is from 6.63 µg/g to 5.08 µg/g and from 5.75 µg/g to 4.60 µg/g respectively. There appears to be no correlation between the protein and the thiamine content of the wheat grain.

## PLANT BREEDING, GENETICS & CYTOGENETICS

### 33. Floral Biology in Mango.

K. ROY CHOUDHURY and SUNIL KUMAR MUKHERJEE, West Bengal.

Studies on floral biology of mango have been undertaken by a number of workers (Burns and Prayag, 1921; Sen, 1946; Bijhouwer, 1937; Naik and Rao, 1943; Mukherjee, 1953 etc.) with a view to find out the flowering behaviour of mango, sex-distribution in the panicle, time of anthesis in different varieties etc. But very little work has been done with the Bengal mangoes.

Recently observations have been made with some Bengal varieties growing in the varietal block of the Horticultural Research Station, Krishnagar, to find out (1) the amount of flowering in the different varieties during the year and (2) the time of anthesis and receptivity of stigma in different varieties prior to undertaking hybridisation between them. While determining the amount of flowering during the year it has been observed by counting the number of panicles within an area of one sq. yard placed at random on four sides of the tree, that in most cases higher number of flowering panicles occur on the east and south sides of the trees than on the other sides. Out of the 12 varieties studied, exception to this has been found in three varieties—Sultan Pasand, Kohinoor and Shadwala. This interesting phenomenon indicates that there may be some correlation of the amount of flowering with the incidence of sunlight, because the plants get more light on the south side than the north from about August to the time of flowering due to decline of the sun to the south. One explanation for this phenomenon may be

the effect of sunlight on the production of flowering hormones. Verification of this observation should be undertaken on a wider scale as it may lead to some changes in the plan of layout of mango orchards.

As a prerequisite to undertaking hybridisation in mango on a wide scale, the time of anthesis and the receptivity of stigmas were observed in 5 varieties of mango. It was found that under Krishnagar conditions maximum anthesis took place between 11-12 noon and the stigmas of the same flowers become receptive immediately. The anthers of the flowers, which open the previous day afternoon, however dehisce in the morning between 6-7 a.m.

#### 4. Observations in the genetic improvement of a green seeded strain of *Cicer arietinus* L.

G. P. ARGIKAR, Bijapur.

Analytical data are presented to indicate the appreciable variation obtained in the protein and ascorbic acid contents of various strains of *Cicer arietinum* L. It is suggested that advantage of such variation could be taken, as is done in the genetic work cited in the paper, in improving the nutritive value of a type by genetic-cum-biochemic studies.

A low yielding small green seeded type possessing green cotyledon, having been found to be rich in protein and ascorbic acid or vitamin 'C' was hybridized with an improved bold, yellow grained high yielding strain 'Bada-Chana' containing low ascorbic acid and protein. The selection made for a combination of all the desirable characters has resulted in the production of a fairly high yielding bold green seeded strain rich in protein and vitamin 'C'.

The green colour of the testa and cotyledon being recessive in character and being associated with high vitamin 'C' content, so also the bold grain size being recessive to the small one, it has been possible to fix up quickly all the desirable characters in a new bold green seeded strain. This supports the case of the importance of genetics in plant breeding.

The author concludes that any plant breeding study aimed at evolving an improved strain of a food crop must necessarily be supported by biochemic analysis of the material on hand lest some good genes for the desirable higher proportion of constituents like protein and vitamins be lost sight of in the process of selection and rejection.

#### 35. Studies on the varietal classification and virus resistance in lady's finger (*Abelmoschus Esculentus* Linn).

P. S. VERMA and SUNIL KUMAR MUKHERJEE, West Bengal.

While undertaking a trial with 43 types of lady's finger received from various nurseries and the Agricultural Departments and from collections made in West Bengal, with the purpose of selecting some high yielding, virus-resistant types at the Horticultural Research Station, Krishnagar, under the scheme on the Improvement of Vegetables in West Bengal, financed by Indian Council of Agricultural Research, it has been observed that there is a great range of variation amongst the different types of Lady's finger (Bhendi) in respect to their vegetative characters and also in their resistance to virus attack. The virus infection has become very terrific in Lady's finger in all parts of West Bengal and the cultivation of the crop may have to be given up unless suitable resistant types are selected or evolved through hybridization. A study of the vegetative characters of different parts of the plant of all the types has been undertaken and analysed. A preliminary report of the same is given below.

Detailed description of 25 types have been given in the paper out of 45 types put under trial, because they appear to be distinct from one another. The main



characters of classificatory value are height of plant and their branching habit; colouration of branches; the characters of leaf (entire or lobed); and the length and colour of fruit. The leaf and fruit characters appear to be characteristic for different types. On the basis of consideration of above characters a rational classification of different types of Lady's finger can be made.

As regards virus infection it has been noticed that there are 3 different types of symptoms appearing on leaf—(a) *yellow veined*, in which the veins become yellow first and other parts turn yellow subsequently, (b) *yellow lamina*—in which the reverse process takes place and (c) *green mosaic*—in which the leaves become deformed and crumpled. The pink types appear almost resistant to virus. The degree of virus resistance in different types under field condition have been recorded.

### 36. Top working of inferior type of fruit trees to superior commercial varieties.

P. S. PARSAI, Pachmarhi.

Experiments conducted in Madhya Pradesh during the last four years have shown that inferior type of mango (*Mangifera indica*), awla (*Phyllanthus emblica*), jamun (*Eugenia jambolana*), ber (*Zizyphus jujuba*), and citrus can be top-worked to superior commercial varieties.

Crown-grafting, side-grafting and budding on shoots growing from pollarded branches or trunks have been successful in top-working mango trees. Crown-grafting and side-grafting are done during the monsoon season when there is cloudiness and plenty of humidity in the atmosphere.

Budding gives best results during spring when maximum temperature ranges between 90°F and 100°F and during June after a few premonsoon showers. On hill stations where the maximum temperature rarely exceeds 100°F budding can be done during summer months also. Pollarding of branches or trunks is done at the time of crown grafting in July and August or in October.

Budding on shoots growing from pollarded branches and trunks has been successful in top-working awla, ber, jamun and citrus. Best time for pollarding and budding these fruit trees is as follows:—

Serial No.	Fruit tree.	Time of pollarding.	Time of budding.
(1)	Awla ...	April and May when the trees are leafless	June and July when there is break in rains.
(2)	Ber ...	Do.	June to September when there is break in rains.
(3)	Jamun ...	October	Spring when maximum temperature ranges between 90°F and 100°F and during June after a few premonsoon showers. On hill stations where the maximum temperature rarely exceeds 100°F budding can be done during summer also.
(4)	Citrus ...	(i) June (ii) October	(i) October & November. (ii) February and March in places like Nagpur where the winters are very mild budding can be done during December and January also.

## PLANT PHYSIOLOGY

57. Accumulation and Movement of Minerals in Bajri (*Pennisetum typhoideum*).

B. V. MEHTA and C. C. SHAH, Anand.

In fixing the quantity and number of doses of a fertilizer to be applied to a soil, it is necessary to know (1) the stage in the life of a plant upto which assimilation of nutrients continues, (2) the stage at which maximum assimilation takes place and (3) the total amount of nutrients a crop requires. In the present paper accumulation and movement of minerals in Bajri has been studied. The crop requires about 75 lbs. of N, 61 lbs. of  $P_2O_5$ , 88 lbs. of K, 17 lbs. of Ca and 9 lbs. of Mg per acre, total dry matter being about 3 tons. Maximum assimilation of nitrogen, phosphorus and magnesium by Bajri plant takes place between the preflowering and milk stages. Almost continuous and steady absorption of potassium takes place during the three periods of growth preceding the dough stage, but after that the plant seems to return a portion back to the soil. A similar tendency is observed in the case of calcium also. At all stages of growth, the percentage of potassium is greater in the stem than in other parts, while that of calcium and magnesium is higher in the leaf than in others. The grain is richer in nitrogen and phosphorus than the rest of the organs.

58. A few observations of the Effect of Colchicine on the root cells of Castor (*Ricinus communis*).

MOHAMMED YASEEN, Hyderabad.

Six different Colchicine concentrations were applied to the newly emerged radicles of castor (*Ricinus communis*) for three days 15, 20 and 30 minutes each day respectively. Colchicine concentrations used were 1.5%, 1.0%, 0.5%, 0.25%, 0.125% and 0.1%. The following effects were observed.

1. All the radicles treated with 1.5% colchicine concentration could not survive as it proved to be lethal.
2. All the concentrations slowed down the rate of growth markedly except the 0.1%. Higher the concentration more was the retardation of growth.
3. Colchicine concentration as low as 0.1% seems to be slightly growth stimulating, for, the treated material with 0.1% solution produced new roots and plumules a day earlier than the control material.
4. Survival percentage was markedly affected; the survival percentage in the lowest concentration used was 46.6 as compared to 95 of control.
5. Hypertrophy of the treated tissue has been observed due to all the used concentrations. Lower concentrations—0.25%, 0.125% and 0.1% caused less hypertrophy and the concentrations 1.0% and 0.5% showed prominent hypertrophy of the radicle tissue.
6. Treated tissue with 1.0% and 0.5% solutions showed the wider intercellular spaces.
7. Much enlarged cells, uniformly filled with cytoplasm were observed. Higher concentrations—1.0% and 0.5% caused more enlargement than the lower ones.
8. Material treated with 1.0% and 0.5% concentrations showed markedly larger nuclei, multinucleated cells and the nuclear fragmentation.
9. Castor plant (control) has the somatic chromosome number  $2n=20$ . Material treated with colchicine showed cells with  $3n=30$ ;  $4n=40$ ;  $6n=60$  and  $16n=160$  chromosomes i.e. polyploidy is induced in castor roots. Concentrations like 0.25% and 0.125% induced many tetraploid cells and a triploid cell 1.0% and 0.5% solutions induced not only tetraploidy and hexaploidy but also hexadecaploidy. These triploid and hexaploid and other polyploid cells were observed in the same tissue i.e. the doubling of chromosomes was not homogenous for the same tissue.



**39. Cold Storage of Field Beans (*Dolichos lablab*).**

H. C. SRIVASTAVA and P. B. MATHUR, Mysore.

Beans are popular as vegetables both in the temperate and tropical regions of the world. They are highly perishable and greatly amenable to deterioration due to desiccation.

Beans in pod and fresh bean seeds were stored at temperatures ranging from 32°F to 88°F. The following conclusions have been arrived at :—

(1) The optimum cold storage conditions for field beans in pod as well as fresh bean seeds are a temperature of 32-35°F and a R.H. of 80-90%. The approximate storage lives are 28 days in the case of beans in pod and 14 days in the case of bean seeds, the approximate post-storage lives at 72-88°F (Mysore room temperature) being 3 days and one day respectively.

(2) The lower the storage temperature, the lower is the rate of respiration both in the case of beans in pod as well as bean seeds.

(3) Storage diseases were due to two fungi, viz. *Colletotrichum lindemuthianum* and *Rhizopus nigricans*.

**40. Cold Storage of Grapes.**

P. B. MATHUR and K. KIRPAL SINGH, Mysore.

The grape vine (*Vitis vinifera*) is native to the Mediterranean, but can be grown in the Tropics also. Certain varieties are highly perishable and the sweeter ones are highly prized for table purposes.

The storage life of Palani-grown white, seedless and sweet grapes at Mysore room temperatures (69-82°F, R.H., 45-92%) is 6 days. When packed in cotton wool, this can be extended to 9 days. By the introduction of potassium metabisulphite in the proportion of 1:2000 by weight, the salt being tied in a muslin bag, the storage life can be extended to 12 days.

With regard to cold storage, it can be stated that these grapes can be stored for 7 weeks at 32-35°F (R.H., 85-90%) with cotton wool packing. By the introduction of potassium metabisulphite in the proportion of 1:2000 by weight, the salt being tied in a muslin bag, the storage life can be extended to 8 weeks.

Data obtained in connection with the chemical changes during storage of grapes showed two distinct trends depending upon whether the conditions of storage were aerobic or anaerobic. Under aerobic conditions of storage there was an increase both in total soluble solids and reducing sugars. The total acid content decreased. Under anaerobic conditions (air-tight polyethylene bag packing), however, decreases in the percentages of total soluble solids and reducing sugars and increases in acidity were noted.

**41. Effect of Different Levels of Plant Potassium on the Uptake of Cations by Bajri (*Pennisetum typhoideum*).**

B. V. MEHTA and C. C. SHAH, Anand.

Potassium is the dominant cation in Bajri. A variation in the exchangeable potassium content of soil as affecting the uptake of basic cations in Bajri plant and their interrelationships have been studied. A wider variation is observed in potassium calcium and magnesium contents of stalks with leaves than in the grain and empty earhead of the bajri plant grown in goradu soil with varying exchangeable potassium content and under different fertilizer treatments. Minimum variation is observed in the grain. A wider variation is observed in the potassium content of the different parts in the bajri plant than in either calcium or magnesium. The total content of the stalk with leaves is higher than that of the other tissues.

spite of the individual variation in the potassium content of the different parts of the bajri plant, the sum of these cations is almost constant. The differences in potassium content are compensated by reciprocal differences in calcium and magnesium. The ratio  $\frac{\text{Ca}+\text{Mg}}{\text{K}}$  in case of bajri plant grown on the soil at different levels of exchangeable potassium and fertilizer treatments, varies from 0.56 to 1.15 for the grain, 0.30 to 1.09 for the empty earhead and 0.42 to 1.44 for the stalk with leaves. It is safe to say that if the ratio is less than 1.5 in grain, empty earhead or straw of Bajri plant at harvest stage, it can be considered that the crop is adequately supplied with potassium.

### 43. Effect of dipping paddy seedlings in nutrient solutions before transplanting.

M. A. IDNANI, A. B. GHOSH and R. K. CHIBBER, New Delhi.

Potculture and small-scale field experiments were conducted during 1952 and 1953 to study the effect of dipping paddy seedlings in nutrient solutions just at the time of transplanting. In order that the nutrients may stick to the roots the solutions were made into an emulsion with sufficient quantity of fine earth.

High increase in paddy yield was observed due to some of the treatments. Dipping the seedlings in 2% solution of ammonium sulphate produced an average increase of 44% grain yield over control, and an average increase of 65% was observed over control due to dipping in 5% solution of ammonium phosphate.

5% soln. of ammonium sulphate proved toxic to the plants. 50% farmyard manure-soil emulsion and a 5% soln. of superphosphate were both found to be ineffective in increasing paddy yields over control. There were, however, fairly wide variations in the yields from the replications probably due to the reason that the amount of nutrients sticking to the roots varied considerably during the dipping.

Field experiments have been undertaken from this year on a bigger scale so as to minimise the experimental error and to get conclusive data.

### 43. Effect of Terpeneol in inhibiting the Sprouting of Potato Tubers during Storage.

P. B. MATHUR and H. C. SRIVASTAVA, Mysore.

Plant hormones have been successfully employed during recent years to prolong the storage life of vegetables. In the present paper some data obtained on the effect of terpeneol—a plant growth inhibitor—in inhibiting the sprouting of potato tubers are presented.

To test the efficacy of this growth-inhibitor, strips of filter paper were soaked in 1.5 c.c. of the hormone and distributed evenly in 25-lb. lots of potatoes (var. Great Scot) packed in gunny bags. Treated and untreated potatoes were stored at 52-55°F, 60-65°F, 71-75°F and R.T. (76-86°F). Treatment with terpeneol resulted in reducing the physiological losses in weight and inhibiting the sprouting at all the storage temperatures investigated. These effects were most pronounced at 52-55°F.

### 44. Essential amino-acid contents of legumes and grasses (Methionine, Cystine and Tryptophane).

Y. P. GUPTA and N. B. DAS, New Delhi.

Different legumes (Lupinus Termis, Berseem, Lucern, Vicia Sativa, Hubam Clover and Bur Clover) and grasses (Phalaris Tuberosa, Phalaris Canariensis, Short rotation rye grass, Dicanthium annulatum and Cortadenia argentina), were analysed for their methionine, cystine and tryptophane contents by the microbiological method.



Legumes and grasses are found to contain variable content of methionine ranging from 0.56% to 0.20% in legumes and 0.27% to 0.08% in grasses.

The cystine content of the legumes varies from 0.068% to 0.022% but grasses it ranges from 0.032% to 0.021% only and the variation is not much.

Legumes and grasses also vary in their content of tryptophane. In legumes tryptophane ranges from 0.0158% to 0.056% while in grasses from 0.0199% to 0.0047%.

As compared to cystine and tryptophane, methionine is found to be sufficiently rich in legumes and grasses. It is only the cystine which is the poorest of all in these materials. There does not exist any relationship among these constituents themselves.

#### 45. Exhaustion of the Soil and Uptake of Nutrients by Different Varieties of Jute Grown under the same conditions.

M. K. MUKHERJEE and S. C. CHAKRAVORTY, Barrackpore.

The differential exhaustion of the high yielding varieties e.g., 040-632 (*olitorius*) and C39-212 (*capsularis*) developed by the Jute Agricultural Research Institute against the two standard strains e.g. C.G. (*olitorius*) and D154 (*capsularis*) under manured and unmanured conditions with particular reference to soil nitrogen was studied. Under manured conditions (ammonium sulphate added at the rate of 250 lbs. per acre) accumulation of nitrogen as also calcium in different parts of the plant is usually higher. The percentage increase is proportionately less in improved strains and this is marked in 040-632. The data for quantity of nitrogen usually returned from the falling leaves and the quantity of returnable nitrogen from the non-fibre producing portions are also presented. Higher yield of *olitorius* and possible cause of response of 040-632 to higher doses of nitrogen has also been discussed. Attempts have also been made to explain certain characteristics of 040-632, the higher yielding *olitorius* variety based on the data of plant analyses. Soil exhaustion studies show no varietal or specific differences in soil properties even after two years of continuous cropping with jute.

#### 46. Mineral Nutrition of Common Crops of Gujarat. Effect of Manganese Part III. Absorption of Iron.

N. M. PARIKH and C. C. SHAH, Anand.

The absorption of iron and manganese by plants is very closely correlated. Symptoms due to manganese toxicity appear to be similar to those of iron deficiency. In this paper the effect of increased absorption of manganese in bajari, bavato, cabbage, cauliflower, guinea grass, guwar, jowar, oat, tobacco and tomato on the absorption of iron is discussed. An increase in the absorption of manganese in the crops studied brings about a decrease in the absorption of iron. If the concentration of iron in the culture solution is varied, a study of the growth of tomato plant shows that increased absorption of iron brings about a decrease in the absorption of manganese.

In the normal healthy tomato plant, the amount of iron in the leaf varies from 118 to 560 p.p.m. and that of manganese from 68.0 to 520.0 p.p.m. For optimum growth of tomatoes, the most favourable conditions are (1) Fe : Mn Ratio 20 : 1 to 4 : 1; (2) Mn concentration 0.1 to 2.5 p.p.m.; (3) Fe concentration 2.0 to 10.0 p.p.m.

### Mineral Nutrition of Common Crops of Gujarat. Effect of Manganese Part II. Absorption of Calcium, Magnesium, Phosphorus and Nitrogen.

N. M. PARIKH and C. C. SHAH, Anand.

A study of the effect of manganese on calcium, magnesium, phosphorus and nitrogen content of bajri, bavato, cabbage, cauliflower, guinea grass, guwar, jowar, tobacco and tomato crops has been reported in this paper. It is observed that with increasing absorption of manganese, there is a decrease in the absorption of calcium and an increase in the absorption of magnesium. At toxic levels, however, there is also a decrease in the absorption of magnesium. For all crops there is an optimum concentration when the absorption of phosphorus is highest. Both below and above this value less phosphorus is absorbed. So long as manganese is deficient, there is an increase in the assimilation of nitrogen, at higher levels, the nitrogen percentage remains fairly steady.

### Mineral nutrition of plants and its relation to the synthesis of ascorbic acid.

S. C. MANDAL, A. S. VARMA and H. N. MUKHERJEE, Sabour. -

Several crops viz., tomato, chilli, lady's finger, spinach, potato and *kalai* (*Phaseolus mungo*) were grown on the loamy soil of Sabour with various fertilizer treatments containing N, P, K, Mg, Mn, Zn, Fe, Cu and B. Zinc caused some increase (2 to 10%) in the ascorbic acid content of tomatoes. Other elements viz., Mn, B, Cu, Fe and Mg, on the other hand, brought about a reduction in the Vitamin C content of the same crop. A rise in ascorbic acid, ranging from 16 to 97% was also recorded in lady's finger (*Lens esculantum*) due to the Zinc treatment of the soil. The Vitamin was found to have increased by 20% (from 1.6 to 29.3 mgms. per 100 gms.) in the chillies by Fe in the month of January. This was the highest value for all treatments. About two months later samples collected from the same Fe treated plots were found to contain lower amounts of ascorbic acid than those from any other treatment. On the other hand the ascorbic acid contents of pods obtained from magnesium treated plots changed from the lowest to the highest value during this period. This indicates that the elements that actuate the synthesis of ascorbic acid in plants differ from each other as regards the time when they become most active.

Ordinarily N P K applied to the Sabour soil may be regarded as right fertilisers for the proper growth of these crops, as well as for optimum ascorbic acid synthesis.

### Retting of Jute : III : Shortening of Retting Period by Means of Chemical Activators.

B. C. KUNDU, M. K. MUKHERJEE, A. K. KUNDU and G. HALDER,  
Barrackpore.

Quality of jute considerably depends upon retting period. The longer the retting period, the inferior is the quality of fibre. Usually retting period depends on two factors—the temperature of the retting water and the volume of water. In Indian Union, in most places jute is harvested at a later period when the temperature is comparatively low, than in Pakistan. Moreover there is acute shortage of retting water in many places. Chemical retting in a central rettery is not a practical proposition under present day Indian conditions. The only practical solution lies in stimulating the growth of micro-organisms responsible for retting by means of activators. Data with several activators have been presented. The period of retting is reduced considerably by ammonium salts but not by nitrates.



Calcium salts and phosphates also reduce the retting period, but the results with different potassium salts have been different.

It may be stated that a mixture of bone dust and ammonium sulphate may be considered economic in places where there is acute shortage of water. Cause of their action in stimulating microbial activity has also been discussed.

#### 50. Studies on the Cold Storage of Mangosteen (*Garcinia mangostana*).

P. B. MATHUR, K. KIRPAL SINGH and H. C. SRIVASTAVA, Mysore.

The mangosteen is generally regarded as one of the most delicious fruits of the East. However, the fruit is still very much restricted in its distribution.

Mangosteens were stored at various temperatures ranging from 32°F to 55°F. The following conclusions have been arrived at:

- (1) The physiological losses in weight were found to be lower, the lower the storage temperature.
- (2) A decrease in total soluble solids, an increase in reducing sugars and decreases in total acidity and ascorbic acid contents were observed.
- (3) The respiration rates were found to be higher, the higher the storage temperature. At all the storage temperatures, the respiration rate dropped rapidly during a period of 28 days and was followed by the climacteric rise.
- (4) The optimum conditions for the cold storage of mangosteens are a temperature of 39-42°F and a R.H. of 85-90%. The storage life is 49 days.

#### 51. Studies in the Cold Storage of Langsats.

H. C. SRIVASTAVA and P. B. MATHUR, Mysore.

Langsat (*Lansium domesticum*) is one of the most popular fruits of the Malay Archipelago and the Philippine Islands. It has also been introduced at the Kallar and Burliar Fruit Stations in Nilgiris.

Langsats were stored at temperatures ranging from 47°F. to 83°F. The physiological losses in weight were found to be lower, the lower the storage temperature. However, the percentage of wastage was found to be the least at 52-55°F. Both the percentages of total soluble solids and reducing sugars increased during storage at all the temperatures. The fruit does not contain any ascorbic acid. The respiration rates were found to be higher, the higher the storage temperature.

Decay during storage was due to *Rhizopus nigricans* and *Aspergillus luchuensis*.

The optimum conditions for the cold storage of langsats are a temperature of 52-55°F and a R.H. of 82-90%. The approximate cold storage life is 14 days.

### PLANT PATHOLOGY

#### 52. Effect of the Cultural Factors on Incidence of Damping-off Disease in the Nursery Beds.

H. C. SRIVASTAVA, Mysore.

The cultural factors play an important role in predisposing the seedlings to damping-off disease. The effect of various cultural factors, e.g., thick and thin sowing, depth of sowing, shade and level of beds, were studied, in relation to the incidence of damping-off in Cabbage (*Brassica oleraceae* var. *caulorapa*), Tomato (*Lycopersicon esculentum* L.), and Balsam (*Impatiens balsamina* L.). It was statistically found out that thick sowing is very injurious, as it creates favourable atmosphere for pathogen to invade the seedlings by increasing their length of

ypocotyl, which ultimately weaken them. Moreover thick sowing also checks the root to go deeper in the soil. The interaction in between different aspects of thick and thin sowing have been discussed in detail, and in Cabbage seedlings it has been found out, that the base infection exhibited much longer roots both in thick and thin sowing, while root infected ones behaved reversely.

The deeper the seed will be sown, the more pre-emergence damping-off will occur, while sowing too shallow causes post-emergence damping-off. Sowing the seeds at 2-4 cms. is safe. Shade increases the length of the hypocotyl, thereby more damage occurs. Sowing of the seeds at low level increases the incidence of the disease due to much humid atmosphere.

### 53. Damping-off of Vegetable and Ornamental Seedlings.

H. C. SRIVASTAVA, Mysore.

The causal organisms of the damping-off disease among 20 different vegetables and 130 ornamentals were isolated, purified, and their pathogenecitical studies in detail were carried out at Government Agricultural College, Kanpur during the years 1949 to 1953. The intensity of damage was also calculated in different nurseries of Uttar Pradesh. A list of pathogenic organisms, responsible for damping-off disease in various vegetable and ornamental seedlings have been made. In general *Pythium aphanidermatum* (Eds.) Fitz., *P. indicum* Balkrishnan, *P. de Baryanum* Hesse, *R. solani* Kuhn, *Sclerotium bataticola* (M. phascoli) and *Sclerotium rolfsii* Sacc. were found much virulent in causing the disease. Whereas *Phytophthora parasitica* Dastur, *Phoma betae*, and *Colletotrichum* sp. were also pathogenic on some of the hosts. It was seen from the results that *P. debaryanum*, was only virulent in severe proportions, during winter, whereas, *P. indicum* and *P. aphanidermatum* in rainy season. *R. solani* was present in both the seasons.

### 54. A Bacterial Disease of *Heliothi obsoleta* F., a Pest of Vegetable and Fruit Crops.

S. K. MAJUMDER, M. MUTHU and S. V. PINGALE, Mysore.

Occurrence of a bacterial disease in *Heliothis obsoleta* is recorded and the etiological studies are described. The disease is shown to spread through either contact of the larvae with each other or through feeding on contaminated food.

The causal organism is isolated and found to be motile, gram positive, and sporulating. When contaminated foods are fed to larva, it is shown to produce blood disorders, change its colour and consistency and cause phagocytosis. Experiments undertaken to control the insect through this bacillus are further discussed.

### 55. Bionomics of Wax-moth *Galleria mellonella* Linn.

R. L. GUPTA and R. R. RAWAT

Life history, different stages, nature and extent of damage and control of *Galleria mellonella*, Linn were studied in 1946-47. The eggs are laid singly or usually in groups of 2 to 200 attached by a gummy material in the silts of hives or on combs. The female moth lays from 500 to 900 eggs. Egg period varies from 5 to 15 days. The larva begins to feed within the cell on the medina septum forming small fine gallery of silk excreta and particles of comb. The larva undergoes five moults. The larval stage varies from 25 to 40 days. The larva pupates within a white silken tightly woven cocoon inside or in between the combs. The pupal period varies from 8 to 10 days. The sexual dimorphism of adult moths has been described. The pest is active throughout the year. It is a serious pest of combs of honey-bees in Madhya Pradesh. The attacked combs



are more or less completely destroyed especially in weak colonies with all the wax being eaten up by the larvae containing a loose mass of silken larval galleries and cocoons.

**56. Contamination of the Grain stored in Jute bags through surface dusting with BHC.**

S. V. PINGALE, Mysore.

A dust containing 5.0% of BHC was used on the surfaces of grain stacks and the contamination passed on to the grain was studied over a period of 6 months. In one case the stacks received dusting every 15th day and in the other every 30th day. Grain samples were drawn every month and were estimated for the insecticide content. The studies revealed that BHC tended to accumulate in the grain at the periphery but even then the contamination left in the grain was very low and did not exceed the permissible limits in 6 months.

It is reported that though the surface dusting failed to show appreciable contamination in the grain some grain available to the consumers from the treated stores contained large quantities of the insecticide. The presence of such large quantities of the insecticide is shown due to the practice of mixing the spilled grain with the grain in the bags.

**57. Impregnation of Jute bags with Insecticides for the Insectfree Storage of Food Grains.**

S. V. PINGALE, Mysore.

Pyrethrins, DDT, dieldrin, aldrin, lindane and piperonyl butoxide were impregnated on jute bags and tested for residual toxicity and repellent action against four insects injurious to the stored grain. These tests revealed that pyrethrin films alone could repel the insects and that the addition of piperonyl butoxide to pyrethrins increased the repellent action and to other insecticides their toxic action.

Synergised pyrethrin impregnations showed promise in protecting wheat flour in the preliminary tests but failed to do so in a commercial test. DDT and dieldrin impregnations were found very stable but their concentrations necessary to protect food grains for 8 to 10 months left contaminations higher than permissible in some food stuffs. Their use therefore is not considered desirable.

Amongst lindane and aldrin, lindane was superior and at very low concentrations was toxic to the insects for 8 to 10 months. It was further seen that much higher concentrations were necessary to leave injurious contamination to even the grain flours and the oil seeds. Lindane impregnations were therefore tested on a commercial scale and from the results presented it is shown that the chemical is suitable for being impregnated on jute bags meant for food grain storage.

Impregnations with combinations of the above mentioned insecticides were also studied and lindane dieldrin combination was observed to give better results.

**58. Life History of *Laspeyresia Pesudonectis* Meyr.**

R. L. GUPTA, Nagpur.

*Laspeyresia pseudonectis*, the sann-hemp shoot borer, is recorded as a major pest of sann-hemp (*Crotalaria juncea*) in Madhya Pradesh. The larva damages top shoots which are formed into characteristic galls as a result of which the upward growth of the plant is retarded and side shoots are given out which lower the value of this fibre crop. The attack also takes place at the axils of the leaves of the main branch where a swelling is formed. There may be more than

e gall in the same plant. When the crop is in bearing, the caterpillar has been found to affect the capsules also. The attack starts in the second week of July when the crop is about 15 days old and continues till the middle of October. As many as 14% plants are attacked in normal years, though the incidence may shoot up under favourable conditions. The maximum number of galls observed on a single plant was 3. A single female laid from 169 to 225 eggs. The oviposition and the post-oviposition periods varied from 2 to 6 and 1 to 3 days, respectively. The incubation period was 3 to 4 days, larval period 21 to 33 days and pupal period from 4 to 10 days. Adults lived from 5 to 10 days. There are overlapping generations and after October the larva remains in a quiescent stage in the silken cocoon and the moths emerge by the end of June.

#### 9. Linseed Gall Fly (*Dasyneura Lini* Barnes) and Its Control.

R. L. GUPTA, Nagpur.

The Linseed gall fly is a very serious pest of linseed in Madhya Pradesh and is responsible for damaging 15 to 20% flower buds. A single female lays from 9-103 eggs on 8 to 17 buds. Incubation, larval and pupal periods vary from 3-5, 4-10 and 4-9 days, respectively. There are 4 generations during the linseed season. The following control measures are suggested :—(a) Early sown variety is less attacked than normal or late sown crops, (b) Fish oil rosin soap and crude-oil-emulsion work as good deterrents, (c) Light traps are found to be most effective. As many as 1,250 flies were trapped in a single night by a petromax in an acre area, (d) of the *Day-trap*, gur-rab and water (in the proportion of 2 ozs. of rab in 10 lbs. of water) attracted as many as 14,105 flies in a single day from 3 A.M. to 5 P.M.

#### 60. Preliminary trials on the efficacy of some of the recently discovered organic insecticides and some plant poisons against the red-hairy caterpillar, *Amsacta moorei* Butler.

P. B. MOOKHERJEE, New Delhi.

There is not much published data on some of these organic insecticides for the control of the red-hairy caterpillar, *Amsacta moorei* Butler. Of the older insecticides, dusting the infested crop with sodium fluosilicate mixed with road dust in 1:8 parts gives a measure of control of the pest. Of the different organic insecticides, dusting the infested crop with 4-5% BHC is the only recommendation made so far.

A series of tests were, therefore, made in the toxicological laboratory of the Entomological Division, I.A.R.I. using DDT,  $\gamma$ -BHC, Aldrin, Dieldrin, Toxaphene, Chlordane and Parathion and two of the plant poisons, Pyrethrum and Nicotine for the sake of determining their effectiveness against this pest.

Observations made so far show that of the organic insecticides used as an emulsion and contact spray, Parathion recorded 60%, 20% and 10% kill respectively in 48 hours in 0.1%, 0.05% and 0.025% strengths. DDT, BHC, Dieldrin and Toxaphene recorded a kill of 38 to 50% in strength varying between 0.0625% to 0.5% in 72 hours, Dieldrin and BHC showing a quicker knock down effect. Aldrin recorded a kill of 13.3 to 23.3% while Chlordane a kill between 3.3 to 10% under similar conditions as DDT, BHC, etc.

Used both as contact and stomach poison, Parathion again recorded a highest kill of 86.6 to 100% in strengths varying between 0.0125 to 0.1% in 48 to 72 hours,



there being a quicker knock down effect in the higher strength and a kill of 86.6% even in the lowest strength of 0.0125%. Dieldrin recorded a kill of 80 to 100% between 0.0625 to 0.5% strengths in 48 to 72 hours; DDT and BHC recorded 46.6 to 100% and 20 to 100% kill respectively under similar conditions, Dieldrin and BHC showing a quicker knock down effect. Aldrin and Toxaphene each recorded a kill of 13.3 to 100% while Chlordane recorded 33.3 to 53.3% kill under similar conditions as DDT or BHC.

Of the two plant poisons used as contact spray in solution both have yielded poorer results. On an average 0.4% Pyrethrin extract was observed to have effected a kill of only 16.6% among the matured caterpillars of the pest against nil in the control in 48 hours. Nicotine sulphate (40%) used in a dilution of 1 : 500 similarly produced on an average only 3.3% kill against nil in the control.

These studies are of great importance because *Amsacta moorei* is one of those pests that is very difficult to control and on which we have so little data at the present moment. The pest is polyphagous and is a regular visitor in the field soon after the first monsoon showers.

**61. Some Biological Factors influencing the Sex-ratio in *Bracon (Microbracon) gelechiæ* Ashmead (Hymenoptera : Braconidae), A Larval parasite of the Potato Tuber Moth, *Gnorimoschema (Phthorimaea) operculella* (Lepidoptera : Gelechiidae).**

E. S. NARAYANAN and S. Z. HAIDER, New Delhi.

Although sex-ratio is often considered to be an approximately constant factor for any given insect species, it is in reality exceedingly variable and fluctuations may be due to a number of causes. Flanders and a number of other investigators have discussed the subject in some detail and have pointed out that in arrhenotokous Hymenoptera change in sex can occur only in mated females and this leads to the conclusion that the sex is determined while the egg is passing through the oviduct.

Our present studies show that in *Bracon gelechiæ* the unmated females produce hundred per cent male progeny but the mated females give rise to varying numbers of male and female progeny. It has been found that such biological factors as the size of the host, host density, inbreeding etc. markedly affect the production of fertilized (female) eggs. The parasite shows a definite preference for the larger host not only for oviposition but also for laying her fertilized eggs. Even forced oviposition on smaller hosts results in a low percentage of female progeny. A comparative study of the sex-ratio recorded on three different species of host has further pointed that it is not the quality of the available food but again the size of the host to which the parasite shows enough preference for depositing her fertilized eggs. Segregation of eggs after they have been laid by mated females does not result in a change of sex-ratio which further goes to show that the sex of an egg is determined before it is laid on the host. Size of a host seems to have a stimulating effect on the spermathecal gland which is the real agent responsible for the fertilization of the eggs.

The production of fertilized eggs is found to rise with the host density upto an optimum of ten hosts per female. Beyond this density much of the time is utilized in paralysing the hosts and out of a total period of 24 hours a very short time is saved for egg laying. Within this limited time most of the eggs laid escape fertilization.

Correlation studies show that the relation between the number of grubs per host and the percentage of female can be expressed (within the limits of the observations) by a straight line. The relation has been found to be negatively correlated.

An inbred female produces much fewer female progeny as compared to an outbred one. From this it would appear that the sex-ratio in this case is genetically determined.

Our observations have also shown that this parasite is able to withhold its eggs during the absence of hosts and that under such restricted condition of position a larger proportion of eggs laid are fertilized.

Preponderance of males in the breeding jars adversely affects the production of female progeny. Experimental evidence has also been obtained that goes to show that more than one mating within a short period impairs the production of fertilized eggs. But there is also an indication that the sperms delivered by one male in one mating is not sufficient for those females which have long oviposition periods.



## SECTION OF PHYSIOLOGY

*President*:—DR. N. N. DAS, M.Sc., M.B.

### METABOLISM AND NUTRITION

#### 1. Histamine and Glycosuria.

SITESHENDRA NATH RAY and DULAL PANDA SADHU, Calcutta.

Injection of Acid Histamine Phosphate in  $10^{-6}$  gm. dose, increases galactosuria in skim milk fed rats and causes excretion of reducing sugar in rats fed whole milk, lactose-fat diet or fat-free lactose diet. Rats fed fat-free diet containing glucose as the sole source of carbohydrate do not excrete sugar when injected with histamine.

This peculiar behaviour of histamine in minute doses may either be due to the neutralization of the beneficial effect of fat in the diet or to the increase of tissue permeability. Experiments show that rats fed fat-free diet containing sucrose as the sole source of carbohydrate, excrete sucrose and some monosaccharides in the urine after histamine injection. Blood sugar does not rise except in rats fed fat-free lactose diet after injection of  $10^{-6}$  gm. of histamine phosphate.

#### 2. Mechanism of Citric Acid Formation and Accumulation in *Aspergillus Niger*.

C. V. RAMAKRISHNAN\*, Ottawa, Canada.

Isotopic studies as well as studies on the isolation of chemical intermediates formed during the conversion of glucose to citric acid by *A. niger* have not yet revealed the exact mechanism of citric acid formation and accumulation in *A. niger*. In the present study, cell-free extracts of *A. niger* mold pellets grown in citrate accumulating medium were examined for the presence of the enzymes of Krebs' citric acid cycle and glycolytic enzymes.

During citric acid accumulation, the specific activity of the condensing enzyme of *A. niger* increased whereas isocitric-dehydrogenase and aconitase are inhibited. Citric acid has been shown to inhibit isocitric dehydrogenase even though the mechanism of inhibition has not been understood. The inability to demonstrate the presence of glycolytic enzymes in extracts of *A. niger* during citric acid accumulation suggests a new pathway for the formation of pyruvate from glucose, different from Embden-Meyerhoff's glycolytic scheme. It is possible a pathway, similar to one suggested by Entner and Doudoroff in the case of *Pseudomonas saccharophila*, may be operating.

#### 3. Nicotinic Acid Metabolism in the Rhesus Monkey.

SACHCHIDANANDA BANERJEE, Calcutta.

Female rhesus monkeys were fed a natural diet mixture with or without supplements of sulphaguanidine, nicotinic acid or dl-tryptophane and urinary excretion of nicotinic acid and amide, nicotinuric acid, n-methylnicotinamide, 6-pyridone, trigonelline, quinolinic acid were estimated. Sulphaguanidine slightly diminished the excretion of N-methylnicotinamide. Nicotinic acid produced an increased excretion of nicotinuric acid, NMN and 6-pyridone. Tryptophane also produced an

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\* will present the paper before the Indian Science Congress, 1955.

ceased elimination of NMN and 6-pyridone. As NMN and 6-pyridone are the excretory products of nicotinic acid metabolism it is observed that monkeys can convert tryptophane into nicotinic acid which is further metabolised into NMN and 6-pyridone. Quinolinic acid excretion is also increased after nicotinic acid and tryptophane. It is probable that when the diet consists of excess of nicotinic acid the tryptophane of the diet is converted principally into quinolinic acid. Xanthine excretion is not affected by the administration of either nicotinic acid or tryptophane.

### **Studies on the Nutritive Value of Plant Proteins, Part II. Influence of Vitamin B<sub>12</sub> on the nutritive value of Pulse Proteins.**

G. C. ESH, Calcutta.

It is now known that pulse proteins have limited nutritive value when compared with an ideal protein say egg protein. Finding that Vitamin B<sub>12</sub> is involved in the metabolism of various amino acids and proteins, experiments were made with growing rats to find out the influence of vitamin B<sub>12</sub> on the digestibility, biological and growth promoting values of proteins available from the pulse-Lentil. At 12% protein level while there was no influence of B<sub>12</sub> on the digestibility and growth promoting value of the Protein the biological value was significantly increased. At 18% protein level, however, both growth promoting value as well as biological value obtained by balance sheet method was significantly increased when the diet was supplemented with vitamin B<sub>12</sub> (20  $\mu$ /100 g. of ration). Further, it is interesting to note that Vitamin B<sub>12</sub> supplementation induced additional growth response over that obtained with methionine supplementation of lentil protein when fed at 18% protein level. Vitamin B<sub>12</sub> was also observed to increase the efficiency of utilization of pulse protein when an enzymic digest was fed to depleted adult rats for the generation of growth.

### **Effect of Methionine and Casein on Acetoacetate induced Hyperglycemia.**

M. C. NATH, C. H. CHAKRABARTI and S. G. NAIDU, Nagpur.

Hyperglycemia caused by daily repeated injection of acetoacetate to rabbits has been found to be completely prevented by supplementing 2% methionine to  $\alpha$ -phosphoryl deficient diet.

Methionine in lower concentration (0.2 to 0.5%), however, failed to prevent acetoacetate induced hyperglycemia.

A partial prevention of such hyperglycemia is observed when the concentration of methionine is maintained at 1% level.

Animals maintained on the diet supplemented with casein (26%) show normal blood sugar value upto 40 days. But as the injection is continued for another 10 days at the following doses of acetoacetate injection: 31st to 50th day, 150 mg./kg.; 51st to 70th day, 225 mg./kg., there is slight tendency of hyperglycemia in these animals.

A direct relationship between the blood glutathione concentration and blood sugar value has been observed. More the depletion of blood GSH, more is the rise of blood sugar brought about by the ketone bodies.

Deficiency of SH compounds seems to be an essential factor for acetoacetate induced diabetes in experimental animals.



**6. Occurrence of Glucose in combination with Acetoacetate in normal urine.**

M. C. NATH and V. K. SAHU, Nagpur.

Glucose has been shown to occur in the combined form with some acetone body in the normal urine.

Both glucose and acetone can be set free from samples of urine from men, rats and rabbits on hydrolysis with HCl.

A new route of glucose utilization as well as ketolysis has been suggested.

**7. Vitamin C Metabolism.**

M. N. RUDRA, Laheriasarai.

The known mode of action of vitamin C in the body has been discussed. The mechanism of the action of vitamin C as a haematinic principle has been explained. The unknown but possible metabolic significance of the vitamin has been suggested. Rudra has also explained the probable function of vitamin C in protein metabolism and in enzyme systems.

**8. Nutrition Problems of the Tribes of Abor hills (Assam).**

P. N. SEN GUPTA, Calcutta.

The problems are based on a part of the investigations carried out in Abor hills in 1948-49, 1949-50 and in 1952. The importance of systematic investigations on the dietaries and various nutritional problems of the primitive tribes including adequacy of foods, deficiency diseases, life expectation, growth of the children and physical fitness has been stressed. Comparative studies have been made on the populations, including male females ratio, proportion of total and per family children and family sizes, in the Padam, Minyong and Pangti tribes. Economic status of the families and its relation to the food supplies, intake of flesh foods, vegetables and cereals has been shown. The Abor beverage *apong* has been found to be useful to provide nutrition to the tribes. Introduction of wet cultivation replacing completely the usual *jhum* cultivation in some areas has resulted in more rice consumption but comparatively much less consumption of leafy and other vegetables and flesh foods, low family sizes, less children, more barren families and lower rate of growth in the children. Padam Abor diets are nutritionally better than many Indian diets. The defects of their diets have been pointed out. Their future in regard to their health, happiness and birth and death rates is not encouraging. Suggestions have been put forward for the improvement of their dietaries, health and nutrition under the existing conditions.

**9. The effect of different levels of Protein intake on the Ascorbic Acid requirement.**

P. B. SEN, Calcutta.

Guineapigs weighing from 175 to 200 gms. were used in these investigations. They were divided into 3 comparable groups and pair fed by stomach tube ensuring sufficient amount of calorie that would prevent superimposition of science of inanition. Scorbutogenic diets containing 17%, 31% and 41% protein with or without ascorbic acid were used. The survival time of guineapigs maintained on high protein diet was very low and in this group, animals lost weight from the very beginning. But supplemented with ascorbic acid high protein diet produced maximum gain of weight in comparable time. Urinary elimination of ascorbic acid also was increased with high protein diet. There was relatively greater amount of

rogen excretion produced with high protein scorbutic diet. Blood and urinary amino nitrogen were increased and urea ammonia ration was decreased.

#### **Endproducts of Protein Metabolism in some Endo-parasites.**

M. M. GOIL, Bareilly College, Bareilly.

The endproducts of Protein Metabolism in some endoparasites like *Fasciola*, *Amphistomes*, and *Moniezia* have been tried. Out of Ammonia, Uric Acid, and Creatinine, it was found that in all the parasites Ammonia and Uric Acid are present. The presence of uric acid has not been reported so far though various workers like Flury and Leeb (1926) and van Grembergen and Pennoit-De Cooman (1944) have worked on these lines. In all investigations Spekker Absorptiometer was used.

### **ENZYMES**

#### **1. Amylolytic enzymes in the saliva of new born infants.**

DR. N. P. BENAWARE and DR. B. B. L. MATHUR, Gwalior.

Needhan (1931) drew attention to the paucity of reliable data on enzymes in mammalian embryos. Klumpp and Neale (1930) demonstrated that amylolytic activity of duodenal contents in human embryos and in the first year of extra-uterine life of infants was very poor. Miller (1941) demonstrated that acidity in stomach juice of infants is very low. Salivary amylase in the new-born infant therefore assumes great importance from the point of view of artificial feeding with carbohydrates.

Saliva was collected in 60 cases immediately after birth by putting a sterile slab of cotton wool rinsed with sterile distilled water in the mouth of the baby. Cord attached to the swab and held outside the mouth prevented its being pulled up. Similarly in another 140 infants, within 24 hours after birth saliva was collected after first rinsing their mouth with sterilised distilled water.

The saliva in all 200 cases was then tested for amylolytic activity (with plain distilled water used as control.) It was found that amylolytic enzyme or enzymes were present in the saliva of all the 200 babies (including 12 premature ones—up to 8 months old.)

#### **2. Comparison of the amylolytic activity of the Saliva of new born infants and adult human subjects.**

DR. N. P. BENAWARE and DR. B. B. L. MATHUR, Gwalior.

In a previous paper authors demonstrated the presence of amylolytic enzyme in the saliva of 200 new-born infants. In the present study the amylolytic activity of the saliva of 26 new-born infants was compared with that of 25 adult human subjects. The saliva of new-born infants was found to possess much less (1/35—1/40th or even less) amylolytic activity than the saliva of adults. It is concluded that nature perhaps did not provide for polysaccharides to be suitable feed for new-born babies.

### **NEUROPHYSIOLOGY**

#### **1. Hypothalamic control over certain vegetative functions.**

B. K. ANAND, New Delhi.

Animal experiments have been carried out to localise some of the vegetative functions in definite hypothalamic regions. Destructive electrolytic lesions were



produced in different hypothalamic regions and their results noted. Stimulations of different hypothalamic regions were also done in unanaesthetised conscious animals by permanently implanted electrodes and the results observed.

**(1) Feeding Responses :—**

Bilateral destruction in the region of ventromedial nucleus produces hyperphagia and obesity and bilateral destruction of lateral hypothalamus in the same plane produces aphagia and death due to starvation. On the other hand, stimulation of lateral area produces increased food intake and stimulation of medial area produces decreased food intake. Lateral area is termed "Feeding Centre" and medial area "satiety Centre". It is shown that these work as 'Facilitatory' and 'Inhibitory' centres for spinal feeding reflexes, and these are further influenced from the neocortex.

**(2) Blood Sugar changes :—**

Stimulations of posterior and lateral hypothalamic regions increase blood sugar levels and stimulations of medial parts of anterior and middle hypothalamus decrease blood sugar.

**(3) ACTH secretion :—**

The ACTH secretion from anterior pituitary is controlled by the medial part of anterior tuberal region.

**(4) Gonadotrophin secretion :—**

The gonadotrophin secretion from anterior pituitary is controlled by the medial part of anterior tuberal region.

**(5) Somnolence :—**

Mammillary region produces behavioural arousal of the animal as a response to peripheral sensory impulses, and thus its destruction produces somnolence and unresponsiveness.

**14. Hyperventilation and E. E. G. changes.**

N. N. DAS.

Of various methods adopted for electroencephalographic routine examination, hyperventilation for 2 to 3 mts. is a part of the examination. This is specially done for detecting whether a person has any epileptogenic condition. It has been found, especially in children, that during hyperventilation the high voltage epileptic discharge comes within 20 to 30 mts. and many last for more than 30 mts. as post-hyperventilation effect. The "activation" by this method is used by all electroencephalographers though other methods are available. The purpose of this study is to collect data about "what percentage of normal subjects within different age groups in this country produces a marked hyperventilation effect, without having any history of convulsive disorder". About 150 cases have been selected of different age groups and EEG record taken with usual method. The findings were recorded in tabular form showing that only a small percentage of said normals show abnormal discharge during hyperventilation.

**15. Studies on E. E. G. of the Deaf and Dumb Teenage School Boys and Girls.**

N. N. DAS.

It is a common belief that handicapped children are very deficient in their intelligence and there is always some defect in the brain. To study the brain condition of deaf and mutes, about 40 students both boys and girls of 12 to 18 years

re selected from the Calcutta Deaf and Dumb School. The usual routine procedure of brain examination with the help of electroencephalograph was adopted. Out 9 electrodes were used in different head areas, right and left frontals, right and left premotor, right and left occipitals, right and left temporals, one vertex, and two ear lobe grounds. The subjects were asked to keep their eyes closed during recording. Most of the subjects showed normal records with good quality sinusoidal alpha with beta activity; some of the records were ideal. This helps studying the brain condition of deaf and dumb which is as good as in normal healthy subjects without much defect. The work is in progress.

## MUSCLE

### 16. Electromyographic Studies on Yoga postures (Yogic Asanas).

N. N. DAS.

Different postures of Hata Yoga are much practised nowadays as physical exercises. The postures or Asanas have great value in controlling the functions of body and mind. The main object of this study is to find out whether the muscles get easily fatigued or can remain in a particular posture for a long time without much fatigue. Electromyograms from different muscles which take part in a particular posture (Asana) were recorded with a Grass, Model III, 8 Channel EEG machine. About 12 different postures were the subject of study of this paper. Two groups of people were selected, for the purpose. One group consisted of young boys of 18 to 20 years who had just started practising these postures, the other group of the same age (including both boys and girls). It has been found that the novices are fatigued easily within 5 to 10 minutes whereas the veterans can remain for hours without much fatigue in different postures (Asanas).

The electromyograms of the novices and veterans reveal the nature of electrical impulse from the particular muscle and actually shows the fatiguability of those muscles. It has been found that veterans in Yogic posture can remain for a longer period without showing any signs of fatigue in the EMG.

### 17. Effect of Rauwolfscine Hydrochloride on the Voluntary Muscles.

J. N. MUKERJEE and P. B. SEN, Calcutta.

*Rauwolfscine*, an alkaloid of *Rauwolfia canescens*, reduces the tone and excitability of the voluntary muscles. The onset of fatigue and the attainment of the clonic and tetanic stage are earlier in *rauwolfscine* treated muscles. These observations on the voluntary muscle contractions may be due to block in the neuromuscular region or to inhibition of the excitability of the muscle fibre by *rauwolfscine*. That *rauwolfscine* acts directly on the muscle fibres is indicated by its action on the curarised muscle.

### 18. Comparative studies on Ionic Exchange in stretched and unstretched muscle.

D. P. SADHU and S. P. BHATNAGAR, Calcutta.

Changes in tension and isoelectric point of muscle occur on stretching. Comparative studies have been made on the effect of different ions and pH on the tension of muscle contracting isometrically under stretched and unstretched conditions.

Tension of stretched gastrocnemius muscle of toad kept in muscle chamber containing Ringer's fluid is recorded by a newly devised apparatus, consisting essentially of a strong spring against which the muscle is allowed to pull. By



means of screw situated above the spring and connected to it, the muscle is stretched to any desired length. The exact length of the muscle stretched is noted by an electro-magnetic arrangement.

With increased concentration of K in the bathing fluid, stretched muscle responds for a longer period than otherwise but the reverse happens with Ca and Phosphate ions. No change is noted in the presence of Na ions. Tension falls to zero earlier in the acidic medium (pH 6.8) whereas no change is noted in alkaline medium (pH 8.4). It is postulated that beneficial effect of Ca ions to isometric contraction is negated by stretching the muscle and that probably stretching prevents the diffusion of K ions outside from inside the muscle fibres.

## HEART

### 19. Mode of action of Cations on isolated Toad's Heart.

ANIMA DEVI and B. B. GHOSH, Calcutta.

Isolated frog's heart was perfused with Ringer solution containing an excess amount of K or Ca ions. Frog's heart perfused with a solution of KCl stops beating within a minute, but revives its original beatings (force of contraction and relaxation, frequency and amplitude are restored) almost instantaneously on washing with Ringer solution. This effect is observed when concentration of KCl in the solution ranges from 0.03 M to 0.5 M. The point of stoppage of heart shifts towards systole when the concentration of KCl in the perfusion fluid is progressively increased till with 0.5 KCl solution the heart practically stops in systole. Revival of the heart is still possible at this stage after prolonged continuous washing with Ringer solution.  $\text{CaCl}_2$  solution has also the same effect. Here also the heart stops almost instantaneously and revives on washing with Ringer solution within a few minutes. Whereas, with concentrated solutions of  $\text{CaCl}_2$ , the heart no doubt stops in systole, but nevertheless could not be revived by continuous washing with Ringer solution. How these ions act; the way these ions can antagonise each other has been very extensively discussed from the point of view of their adsorption on cell surface which has been assumed to consist of polar and dipolar groups. The number of ions adsorbed on the cell surface was calculated on the basis of the forces between ion-ion, ion-dipole, dipole-dipole as well as Vander Waals'.

### 20. Studies on Piscine Heart.

S. K. MAHALANOBIS and D. ROYCHOWDHURY, Calcutta.

In course of the investigation carried on fish heart, it has been found that adrenaline applied directly on the heart of *Opicephalous punctatus*, Singhi and Magur has no marked effect on the heart beat. The beats are slightly augmented but there is no appreciable rise in the frequency. Heart once treated with adrenaline seems to become more or less resistant to the action of adrenaline. If, however, 1 cc. of 1 in 10,000 solution of adrenaline is applied along with the perfusion fluid, there is a pronounced rise both in frequency and amplitude. 1 cc. of 1 : 10,000 atropine sulphate solution increases the course of contraction of heart beat probably by paralysing the parasympathetic nerve endings. 1 : 1,000 solution of atropine has been found to be toxic to piscine heart. Nicotine has more or less same action. It increases the course of contraction in dilute doses and in strong doses the heart stops beating in the relaxed condition. The heart regains its normal rhythm very soon. Acetyl choline in doses of 1.5 cc. of 1 : 150,000 solution markedly depresses the activity of the heart. Stimulation of vagus causes

complete stoppage of the heart. The properties of piscine cardiac muscle is essentially same as those of amphibian and mammalian hearts. Automatic rhythmicity, circase phenomenon and summation of stimuli have been studied. Stennius ligatures have been performed.

The piscine blood has been found to contain the following enzymes :

Carbonic anhydrase, (2) Peroxidase, (3) Catalase and (4) Glutathione. The electrolyte concentration of piscine blood are as follows :

NaCl	...	...	...	590-620 mg. %
KCl	...	...	...	12-16 mg. %
CaCl <sub>2</sub>	...	...	...	8-10 mg. %

The heart has been found to contain the following compounds in concentrations given below :

Inorganic phosphate	...	...	...	3.8 mg./gm.
Nitrogen	...	...	...	6.803 mg./gm.
Pentose	...	...	...	1.210 mg./gm.
Creatin phosphate	...	...	...	0.024 mg./gm.

The glycogen content of heart has been found to vary from 12-15 mg./gm. It is fairly stable and does not diminish even after prolonged work.

#### 1. Existence of a Cardio-stimulating Factor in Cobra Venom.

R. GHOSH, N. K. SARKAR and S. R. MAITRA, Calcutta.

Cobra venom (*Naja Tripudiana*) solution heated at 90°C is found to be as toxic as the unheated venom solution, although most of the toxic principles present in crude venom are destroyed on heating to this temperature for 30 minutes. An isolated frog-heart, if kept immersed in such a heated venom solution, continues beating for nearly 14-16 hours. An isolated frog-heart, on the other hand, beats for 3-4 hours when kept immersed in Ringer-Lock solution and 10-12 minutes in an unheated venom solution. Heated or unheated solutions of plasma proteins, such as albumin, globulin etc. could not however replace the heated venom solution. Heated plasma or blood does not possess this cardio-stimulating effect of heated venom solution.

#### 2. Experimental production and maintenance of Auriculo-Ventricular nodal rhythm in mammals.

R. B. ARORA and P. K. DAS, Jaipur.

Auriculo-ventricular nodal rhythm was produced in 50 dogs, 4 monkeys, 2 cats and 2 rabbits by crushing Sino-auricular node, and was stably maintained for up to 6 hours.

The heart was approached from the right through the space between second and sixth ribs, sternum and anterior axillary line. The chest wall overlying this area was incised and retracted laterally, the right internal mammary vessels having been ligated and cut. Sulcus terminalis was exposed by incising the pericardium and the area of S.-A. node was crushed with a curved artery forceps. The chest wall was thereafter closed. The A.-V. nodal rhythm thus produced was confirmed by Lead II and Unipolar pericardial lead recorded by Grass inkwriting oscillograph. Electro-cautery was used for operation and glucose 5% in isotonic saline was continuously infused. The technique was found much more suitable for tropical countries than the previous 'open chest' technique.



Three types of A.-V. nodal rhythms were seen. Cardiac rate diminished by 14 to 48% (26%) and blood pressure lowered by 0 to 46% (20%) on crushing S.-A. node.

The selection of big healthy animals with good initial blood pressure, operated under low atmospheric temperature with a technique entailing minimum of shock, were found essential for longer and stable maintenance of A.-V. nodal rhythm.

## BLOOD

### 23. Coronary Vasodilators and Blood Coagulability.

C. L. MALHOTRA, New Delhi.

Animal experiments have been carried out to see the effect of commonly used coronary vasodilators-methylxanthines and khellin on prothrombin time and blood coagulation time. The following conclusions have been arrived at as a result of this study.

1. There is species difference in the normal blood coagulation time.
2. Methylxanthines whether taken orally or given parenterally hasten the coagulation of blood. The effect is more marked with aminophylline than with theophylline sodium acetate and also comes on early with the former being maximum three hours after administration than with the latter where it is maximum twenty-four hours after administration.
3. Khellin whether taken orally or parenterally does not adversely affect the blood coagulability and prothrombin time and if anything, it slightly delays the blood coagulation.
4. Under the light of these observations it has been suggested that some anticoagulant should always be used along with aminophylline when the latter is being used as a coronary vasodilator in cases of coronary thrombosis to avoid further spread of the process which might occur as a result of aminophylline administration alone. Khellin, however, does not suffer from this drawback, but its clinical status as a vasodilator has not been settled as yet.

### 24. Studies on the action of Kukscine—the active principle isolated from the *Vernonia cinerea* (less) on the Tracheal chain and Lung perfusion.

AJIT MAITI, and B. B. SARKAR, Calcutta.

Kukscine hydrochlor—the active principle isolated from the *Vernonia cinerea* (less) (Beng.—Kukshima) has got marked stimulating action on the striated and plain muscles. The action of kukscine on the tracheal musculature and lung perfusion has been studied in this section so as to see any constriction or dilatation of the bronchioles could be caused by the drug. Tracheal chain preparation was done by the method of Castillo J. C. and others and the drug kukscine hydrochlor (0.5 mgm.) caused a slight dilatation of the trachea which suggested that the drug has got some spasmolytic action on the trachea. The spasmolytic effect of Kukscine hydrochlor was determined by its efficacy in relieving the spasms induced by histamine phosphate and barium chloride. Kukscine hydrochloride in the dose of 5 mgm. relieved spasms or contraction of the tracheal musculature caused by 1:500-000 of histamine phosphate. Similarly kukscine hydrochlor counteracted the spasmogenic action of barium chloride (1:5000) by the addition of 4 mgm. of the drug.

Lung perfusion technique was followed by the method of Sollmann and von Oettingen and by Ambrose and De Eds. In ten guineapig's lung preparations 0.5 mgm. of kukscine hydrochloride invariably caused dilatation which was poten-

ted by epinephrine (1 : 10·000) and antagonised by histamine (1 : 20·0000). The striction caused by histamine (1 : 200·000) was much relaxed by kukscine (2 to ngm.). But kukscine enhanced the effect of acetyl choline (1 : 100·000). Thus kscine hydrochlor has got definite spasmolytic action on the trachea and bronchial musculature which can counteract the spasmogenic action of histamine and rium chloride.

### 5. Effect of Kukscine—the active principle of *Vernonia cinerea* (less) on the clotting activity of blood.

JIT MAITI, B. B. SARKAR and BHUPENDRA NATH CHAUDHURI, Calcutta

Kukscine, the active principle isolated from the leaves of *vernonia cinerea* as got marked pharmacological actions on the different systems of the body and such the effect of the drug on the clotting activity of the blood in vitro and in vivo has been studied in this section. Kukscine hydrochlor (0·5 mgm.) hastens the coagulation time of cat's blood and with doses from 2 to 5 mgm. per kgm. the drug caused a rapid lowering of the coagulation time when injected intravenously. The initial clotting time 2 minutes 30 seconds  $\pm$  20 seconds decreased to 40 seconds  $\pm$  15 seconds within two hours after the intravenous injection of the kukscine hydrochlor. The coagulation time of rat's blood retarded rapidly from 1 minute 50 seconds  $\pm$  15 seconds to 40 seconds  $\pm$  12 seconds when a dose of different strength of kukscine hydrochlor (0·2 mgm. to 5 mgm. per 100 gm.) was injected through its tail vein. The experiments on the rats were repeated for 15 consecutive days to see the effect of the drug on the coagulation time. The coagulation time did not remain retarded for more than 6 hours as it again came to normal level after 6 hours of the injection of the drug. The second injection of the drug after 6 hours retarded the coagulation time but not to the same extent as in the case of normal. After 8 to 10 days consecutive injection of the single dose of the kukscine hydrochlor rat's blood did not show marked change in the coagulation time as in the cases of normal. The drug kukscine hydrochlor had no action in shortening the coagulation time in vitro *i.e.*, it had no action on the shed blood. Further the toxic doses of kukscine hydrochlor (25 mgm. per Kgm.) when injected intravenously caused no intravascular clotting. The clotting time of blood was determined by Lee & White method modified by Maiti and Sarkar and Sen, Mukherjee and Maiti.

### 26. Erythrocyte count of Rats.

BHUBON MOHAN ROICHAUDHURI, Calcutta.

Due to the scarcity of reliable values of normal erythrocyte counts of rats of Indian laboratories, an investigation was carried out and statistically significant results were obtained from a large number of observations. The mean values of the normal count of the males and the females were 8·19 and 7·17 millions per cubic millimetre respectively. The differences between the values of the male and female sex counts were found to be statistically significant.

## PHARMACOLOGY

### 27. Site of Hypotensive Action of Rauwolsine Hydrochloride.

J. N. MUKHERJEE and P. B. SEN, Calcutta.

*Rauwolsine*, an alkaloid of *Rauwolfia canescens*, has been found hypotensive. In this paper, the site of hypotensive action of this alkaloid has been investigated.



For this investigation, Heymans isolated head technique was employed. It has been found that *rauwolescine* in dose of 1 c.c. per kg. of 1:1000 followed by 2 c.c. of 1:1000 lowers the blood pressure in the femoral artery of the recipient cat by 35 and 50 mm. of mercury, when it is injected into the recipient's body circulation. The above doses, injected into the head circulation of the recipient cat, do not lower the blood pressure in the femoral artery of the recipient cat, which indicates that the alkaloid produces hypotension acting centrally and not peripherally.

## 28. Determination of Toxicity and Therapeutic dose of Rauwolescine.

J. N. MUKHERJEE and P. B. SEN, Calcutta.

The toxicity has been studied on different species of animals and different routes of administration have been followed. It is observed that mice develop toxic symptoms with higher dose of *rauwolescine* in the intravenous route than rats, rabbits and cats. The therapeutic dose of *rauwolescine* has been found to be 0.5 mg. per kg. intravenously in cats and toxic dose of *rauwolescine* 10.78 mg. per kg. intravenously, as determined by the intravenous drip method in the same animal. The margin of safety between the therapeutic and the toxic dose is much greater in *rauwolescine*, where toxic dose is about 22 times greater than the therapeutic dose. There may be some possibility for its use as hypotensive drug therapeutically.

## 29. A new Anti-histaminic Substance.

J. N. MUKHERJEE, P. B. SEN and AMAL KUMAR BISWAS, Calcutta.

*Rauwolescine*, alkaloid of *Rauwolfia canescens*, has been found to be a potent anti-histaminic on isolated guineapig's ileum, in the spray test and against intracardiac histamine administration. In addition it antagonises spasmogenic effect of acetyl choline and histamine. Using the intracutaneous wheal test in guineapigs, *rauwolescine* has been found to be an antihistaminic.

## 30. Biological effect of Macromolecular substances.

K. L. MUKHERJEE and G. WERNER,

*School of Tropical Medicine, Calcutta.*

Substances with high osmotic pressure because of their physiochemical properties were considered suitable for use as plasma substitutes. They were supposed to stay in the circulatory system for some time after their administration and thus maintain an increased plasma volume in states of dehydration and shock. The biological effects produced by two such substances namely Dextran and Polyvinylpyrrolidone of different molecular weights were investigated on rhesus monkeys. The experiments were carried out under dial anaesthesia after ligaturing the renal pedicles. The main effects noted after infusion of dextran (mean molecular wt. 70,000; 0.3 g./kg.) were: reduction of plasma volume, total circulating protein and red cell mass amounting to 20-40%; and increase of extracellular fluid volume. Similar effects were produced by polyvinylpyrrolidone (mol. wt. 30,000 60,000; 0.17 g./kg.). In addition a total transfer of 40-70 mEq. of chlorides took place into the readily diffusible extracellular space. But an infusion of polyvinylpyrrolidone of lower molecular wt. (mol. wt. 12,000) produced an increase of plasma volume and total circulating protein, although the extracellular fluid did not show any significant change.

These observations suggest that different types of macromolecules may give rise to quite distinct and different alterations as regards the body fluids, circulating protein and electrolyte compartments.

### The Actions of Kukscine—the active principle isolated from *Vernonia cinerea* (Less) on the Plain Muscles.

AJIT MAITI and B. B. SARKAR, Calcutta.

Kukscine, the active principle of *Vernonia cinerea* (less) (Beng.-Kukshima) has a very marked action on the striated muscles, the excitability, the contractility the tone of the muscles increased. The fatiguability of the striated muscles decreased. The crude extract of the *Vernonia cinerea* (less) increased the tone peristaltic movements of the intestine and markedly augments the tone and of contractions of the virgin uterus. In moderate dilutions (0.5 mgm.) of the principle, the kukscine, the peristaltic movements of the guineapig's ileum increased. But with higher dilutions (*i.e.* 2 mgm. of kukscine) there is slight loss of tone followed by immediate increase of tone and rate of contraction of the isolated strips of guineapig's ileum. The drug kukscine in the dose of 2 mgm. caused a transient relaxation followed immediately by an increase of tone and contractions. It antagonised the relaxation caused by adrenaline (*i.e.*, 1 : 20,000) on the isolated strips of ileum with the dose of 2 mgm.

0.5 mgm. of the kukscine hydrochlor caused a marked increase of tone of the isolated strips of virgin uterus of rats, guineapigs and cats. The drug kukscine hydrochlor increased the rate and force of rhythmical contractions of the uterus. When it is assayed biologically with the pituitrin it is found that 2 mgm. of kukscine hydrochlor caused the increase of tone and rate of contractions of the isolated strips of uterus as caused by 0.5 U.S.P. unit of posterior pituitary extract. Kukscine hydrochlor in the dose of 5 mgm. antagonises the action of adrenaline (1 : 10,000) on the uterine segments. It has no antagonising effect on the action of ergotoxine on the uterus and similarly the ergotoxine has no antagonising effect on the action of kukscine on the uterine segments.

### A comparative study of Oxygen Consumption by tissue slices of normal and Alloxanized Rats.

GANGAGOBINDA BHATTACHARYA, Calcutta.

In an attempt to explain the mode of diabetogenic action of alloxan in animals a comparative study of oxygen consumption by tissue slices of different organs of normal and alloxan treated rats was undertaken. Some organs like the liver of alloxanized rats showed normal oxygen consumption, whereas some other organs like the kidney showed the markedly depressed oxygen consumption. The depression of oxygen consumption of kidney slices due to alloxan treatment could be counteracted by simultaneous treatment with glucose. Studies on the increased oxygen consumption due to added substrates like pyruvate, succinate, glucose etc., as well as a comparative study of different enzyme activities of the organs of normal and alloxan treated rats tend to show that the decreased oxygen consumption of kidney slices of alloxanized rats is possibly due to inhibition of some enzyme or enzymes concerned with the conversion of glucose to lactic acid. The significance of these results with respect to the diabetogenic action of alloxan has been discussed.

### Effect of Rauwolscine on the central nervous system.

J. N. MUKHERJEE, P. B. SEN and N. N. DAS, Calcutta.

The results indicate that *rauwolscine* is neither acting on the nerve fibres, sensory or motor, nor on the spinal centres, ganglia and neuromuscular junctions. The reduction in tone and excitability produced by *rauwolscine* in the voluntary muscles is probably due to its action directly on the muscle fibre and not through



the nerves. It relaxes also the denervated preparation of sartorius muscle. It cannot be conclusively stated that it does not act in the neuromuscular junction, but it can be concluded here that it acts directly on the muscle (curarised gastrocnemius muscle). It decreases the voltage of brain potentials in higher dosage probably because the excitability of all the muscles is reduced, thereby the afferent impulses reaching to the brain are a minimum.

#### 34. A Hypnotic Action of Rauwolscine.

N. N. DAS, P. B. SEN, J. N. MUKHERJEE and M. N. RAZDAN, Calcutta.

*Rauwolscine*, an alkaloid of *Rauwolfia canescens*, has been found to possess a hypnotic property. It has been observed that *rauwolscine* in dose of 2 mg. per kg., injected intravenously, can produce hypnosis in rabbits. Electroencephalographic study has corroborated this result, where signs of hypnosis have appeared in the electroencephalogram.

#### 35. Comparative Studies of Rauwolscine with Yohimbine on the Blood Pressure and Respiration.

J. N. MUKHERJEE and P. B. SEN, Calcutta.

*Rauwolscine* is regarded as one of the possible stereo-chemical isomers of *yohimbine*. This chemical resemblance of *rauwolscine* and *yohimbine* has got some bearing on the pharmacological properties. It has been observed that these alkaloids resemble each other in the hypotensive, adrenolytic and respiratory depressant actions, but the intensity of the various responses to those alkaloids are of different order.

#### 36. Effect of Rauwolscine on the Cholesterol and Ascorbic Acid Content of Adrenal Gland.

P. B. SEN, AMAL KUMAR BISWAS and J. N. MUKHERJEE, Calcutta.

In this part of the investigations, *Rauwolscine*, an alkaloid of *Rauwolfia canescens* has checked the reduction of cholesterol and ascorbic acid content in adrenals produced by previous administration of adrenaline. *Rauwolscine* was found to annul the effect of adrenaline on the heart contraction and blood pressure. This part of the investigation has revealed that *rauwolscine* has got here also an anti-adrenaline action.

#### 37. Local Anaesthetic Effects of Mephenesin.

B. N. CHOWDHURI and D. P. GHOSH, Calcutta.

A comparative study of the local anaesthetic effect of mephenesin (myanesin), procaine hydrochlor, antistine, d-tubocurarine, nupercaine and amylocaine by the intracutaneous wheal method in guineapigs, shows that the activity of these drugs increases in the order they are mentioned. The activity of mephenesin is about three-fourths that of procaine and about half that of antistine. d-Tubocurarine is about 8 times, nupercaine 40 times and amylocaine 100 times more active than mephenesin.

#### 38. Effect of Kukscine on the Haematological studies of rabbits.

AJIT MAITI, B. B. SARKAR and HRISHIKESH JANA, Calcutta.

The kukscine hydrochloride—the active principle isolated from *Vernonia cinerea* (less)—has got marked physiological actions on the heart, striated muscles

plain muscles which suggested its therapeutic importance in the Pharmacology. haemotoxic effects of the kukscine hydrochlor has been studied with the red erythrocytes of rabbit by the method of Sanford and Todd. Haemolysis of the erythrocytes of rabbits blood treated with 5 mgm. of kukscine hydrochlor 10 cc. occurred at the same salt concentration as in the respective controls. This may suggest that kukscine hydrochloride has no haemotoxic action on the erythrocytes of rabbit's blood.

Normal blood cells counts, haemoglobin estimation, haematocrit volume, platelet counts and the differential counts were carried on rabbits and rats before and after the intravenous injections of kukscine hydrochloride in varying doses (0.5 mgm. per 100 gm. of rats and 0.5 to 10 mgm. per kgm. of rabbits). It is evident from the results that the drug kukscine hydrochlor has no marked effect on the haematological pictures of rabbits and rats when injected in the varying doses. Only there is a slight increase in the eosinophil counts of the w.b.c. i.e. eosinophil count increased from 2% to  $10 \pm 3\%$ .

### **The Antiveratrinic action of various Cinchona alkaloids and Cupreines.**

R. B. ARORA and P. C. DANDIYA, Jaipur.

The work was undertaken with a view to find out a better substitute for veratrine in the treatment of muscular disorders.

The antiveratrinic action of the Cinchona alkaloids Cinchonine and Cinchonidine and the nearest chemical structures i.e.; Deoxy-cinchonine, Deoxy-cinchonidine, Di-hydroquinidine, Cupreine and Di-hydrocupreine besides that of Quinine (which was taken as standard for comparison) and Quinidine was determined on sartorius muscle of frog suspended in twin chambers in bi-carbonate buffer solution. Supramaximal shocks (40 volts, duration 0.5 millisecond) were applied to the muscle in the bath fluid by a GRASS STIMULATOR delivering square waves.

In all 68 experiments were performed in which Veratrine response was produced by Veratridine 1 : 10,000,000. In appropriate concentration these compounds not only abolished the veratrine response but also prevented it by pretreatment of the muscle with these antiveratrinic agents. Cinchonine and Cinchonidine showed maximum antiveratrinic activity.

(1) It appears that both the deoxidation of  $\text{CHOH}$  at the 4-carbon of the Quinoline ring and hydrogenation of the vinyl group lower the antiveratrinic property.

(2) Unsubstituted hydrogen at the 6-carbon of the Quinoline ring gives the maximum antiveratrinic action which decreases by an  $-\text{OH}$  substitution. Substitution by  $-\text{OCH}_3$  again enhances the activity.

### **A study of the Antiveratrinic Activity of Antimalarial Drugs.**

R. B. ARORA and P. C. DANDIYA, Jaipur.

The antimalarial drug quinine which is useful in Myotonia Congenita has both antiveratrinic and anti-accelerator cardiac activity. It was thought that this might well be a property of all antimalarial drugs. The work reported herein confirms this assumption.

The antiveratrinic action of quinine was compared with other antimalarial drugs i.e. Pamaquine, Camoquine, Mepacrine, Cupreine and Paludrine, on the sartorius muscle of frog suspended in bicarbonate buffer solution and supramaximal shocks (40 volts, duration 0.5 milliseconds) were applied to the muscle by a Grass stimulator delivering square waves.

In all 54 experiments were performed in which veratrine response was produced by veratridine 1 : 10,000,000. In appropriate concentrations these compounds



not only abolished the veratrine response but also prevented it by pretreatment of the muscle with these antimalarial drugs. Camoquine showed the maximum antiveratrinic activity (in dilution upto 1 : 1000,000) followed by mepacrine, pamaquine, quinine, cupreine and paludrine.

It appears that the presence of the quinoline ring may be responsible for the antiveratrinic activity of these compounds and that chlorine substitution on the ring increases this activity.

In the authors' opinion Camoquine might prove superior to quinine clinically not only in skeletal muscle disorders but also in its antiaccelerator activity.

#### 41. Effect of Extract of *Symplocos Cortex* (Bengali Lodh) on the Toad's Heart.

R. N. ROY and N. N. DAS, Calcutta.

The effect of aq. extract of *Symplocos cortex* (Beng. Lodh) was studied in this experiment. The aq. extract, 1 cc., 1 : 10, when applied directly on the toad's heart causes temporary slowness of heart beat. The amplitude is short, and rates slow down. A slightly increased dose causes stopping of heart in diastole, but on washing with Ringer solution it returned to normal. The same effect was found in perfused toad's heart.

### ENDOCRINOLOGY

#### 42. The nature of influence of the thyroid on gonads.

AMIYA B. KAR, Lucknow.

It is now a textbook commonplace that the thyroid has a profound influence on the gonads. Beyond this generality, however, little is known about the precise nature of this influence. Investigations carried out in this laboratory have demonstrated that: (1) Simultaneous administration of thyroxine and high doses of serum gonadotrophin to pre-pubertal female rats causes expected acceleration of ovarian function as indicated by a drop in its total cholesterol concentration and the estrus changes in the uterus. But the pathological side-effects of precocious ovarian stimulation by gonadotrophic hormone like cyst formation, abnormal maturation of all the available oocytes at one time and follicular haemorrhage are definitely blocked. These suggest that thyroxine only allows physiological amounts of the trophic hormone to be utilized by the ovary and that the excess gonadotrophin is inactivated. (Kar *et al*, *Arch. Int. Pharmacodyn.*, 97, 1954).

(2) Gonadotrophin has evident thyrotrophic influence which is not direct but is exerted in an indirect manner through the stimulation of pituitary TSH production (Kar *et al*, *Acta Endocrinol.*, 1954).

These findings suggest that (a) primarily, the thyroid regulates the utilization of gonadotrophic hormone by the gonads and (b) on occasions like puberty, when the gonadotrophin output of the pituitary is accelerated, a greater thyroid activity is essential for efficient regulation of gonadotrophin utilization by the gonads. This is accomplished through the ability of gonadotrophic hormone to stimulate the production of TSH. The latter in its turn enhance thyroid activity.

#### 43. Responses of the adrenals of Thyroxine-treated rats to Adrenocorticotrophic hormone (ACTH).

AMIYA B. KAR, Lucknow.

Thyroxine treatment causes a fall in ascorbic acid, cholesterol, lipid and ketosteroid content of the rat's adrenal cortex. These signify an acceleration of secretion.

ary activities of the gland in order to meet an increased demand for corticoids associated with hyperthyroid condition. Further depletion of these substances after CTH administration suggests that the adrenal is capable of responding to a superimposed stress. The probable mechanism responsible for such ability of the gland to heavy physiological demands is discussed.

#### 4. Oxytocic Activity of Vitamin C.

B. N. CHOWDHURI, Calcutta.

Preliminary experiments with rat, guineapig, rabbit and human (excised) uterus show that vitamin C has got definite oxytocic property. The work is in progress.

#### 45. Testicular activity of the rats as influenced by atmospheric temperature and by different doses of thyroxine.

D. N. MULLICK and N. D. KEHAR, Izatnagar.

It was reported earlier from these laboratories that climatic factors were responsible for variations in the physiological behaviour of animals. The present experiment was undertaken to study the effects of summer and winter months on the activity of the testis.

8 normal male adult rats 180 days old were sacrificed in winter months, the air temperature being 60°F. In summer months when the air temperature was about 100°F, 48 male rats of about 160-165 days old were divided into 6 groups of 8 rats in each group. One group was fed on stock diet; the other five groups were receiving stock diet supplemented with 0.1% thiouracil (BDH) and simultaneously were injected with different doses of thyroxine solution (3.7 microgram per 100 gm. body weight). After 15 days the animals were killed and the testis were removed and weights were recorded.

It was observed that the activity of the testis as measured by the weight of the glands decreased with the increase in the atmospheric temperatures, the mean values being 1007 and 773 mg. at 60 and 100°F. respectively. The weight of the glands increased with the increased doses of thyroxine.

The weights were inversely proportional with the increase in the air temperature so also the activity as was shown from the histological structure. The histological appearance showed increased activity with the increased injected doses of thyroxine solution in summer months.

#### 46. Cytological changes in Thyroid produced by Anti-thyroid Drugs and Iodide.

BHUBON MOHAN ROICHAUDHURI, Calcutta.

Iodide inhibits the goiterogenic action of thiouracil and potentiates that of sulphaguanidine acting on thyroid. Administration of iodide on drug treated hyperactive thyroids does not alter the reaction of the colloids with histological stains. Thiouracil depresses the intensity of Feulgen reaction but sulphaguanidine does not. Iodide restores to some degree the nuclear Feulgen reaction of the thiouracil treated glands, but iodide administered to sulphaguanidine treated glands markedly inhibits the reaction. This may be due to the toxic effect of the accumulated iodine within the cell.

The cells of the inactive follicles show an intense plasmal reaction than those of the active follicles. Both thiouracil and sulphaguanidine exert almost no effect on the plasmal reaction. But iodine administration on the drug-treated glands profoundly depresses the reaction. It has been found that neither the drug nor



the drugs nor the drugs plus iodide cause any characteristic change in the nature of the basophilic reaction of the cytoplasm.

#### **47. Anti-thyroid Drugs and Iodide on Mitosis.**

BHUBON MOHAN ROICHAUDHURI, Calcutta.

Both thiouracil and sulphaguanidine produce increased mitotic activity in the follicular epithelium of thyroids of albino rats. In this respect sulphaguanidine has been found to be more potent drug than thiouracil, where about 80% increase in mitotic activity has been noticed. Administration of sodium iodide, to the sulphaguanidine treated animals causes a further increase in mitosis. Iodide administration to the thiouracil treated animals brings about a 10% increase over that of thiouracil treated thyroids. The thiouracil treated thyroids show only about 10% mitotic activity. Thyroids treated with both sulphaguanidine and iodide showed 100% mitosis.

#### **48. Effect of Ovariectomy, Subcutaneous Grafting of Ovaries and Administration of Ovarian Hormone (Oestroform) on the Rate of Respiration, Body Temperature and Blood Morphology of Rabbits.**

D. P. MUKHERJEE, B. C. JOSHI and P. BHATTACHARYA,  
Izatnagar, U.P.

It has been found that ovariectomy decreased and ovarian grafting in the bilaterally ovariectomised rabbits increased the rate of respiration, the total red and white blood cell counts and the percentage of neutrophiles. Removal of the ovaries increased and their grafting decreased the percentage of lymphocytes. The removal and grafting of the ovaries had no significant effect on the percentage of monocytes, eosinophiles and basophiles.

Subcutaneous administration of 15,000 i.u. of oestradiol benzoate increased the rate of respiration, the percentage of neutrophiles and decreased the total red blood cell count and the percentage of lymphocytes and eosinophiles. Administration of the hormone had apparently no effect on body temperature, the total white blood cell count and the percentage of monocyte and basophiles.

#### **49. Studies on ascorbic acid content in the semen of hill bulls and buffalo bulls and its correlation with the seminal fructose and semen quality.**

K. PAL, S. N. LUKTUKÉ, S. K. DE and P. BHATTACHARYA,  
Izatnagar, U.P.

The present investigation was conducted with a view to studying the normal variation in the ascorbic acid content of semen in Kumauni Hill bulls and buffalo bulls and to find its influence, if any, on the seminal fructose and semen quality. In all, 112 samples of semen from eight hill bulls and 146 semen samples from eleven buffalo bulls have been studied. Semen was collected in the artificial vagina from individual animals once a week and two ejaculates were obtained in rapid succession on collection days. The mean ascorbic acid content in the semen of hill bulls was found to be 14.88 mg./100 ml. for the first ejaculate and 14.98 mg./100 ml. for the second ejaculate. In the buffalo bull, it was 3.78 mg./100 ml. for the first ejaculate and 3.80 mg./100 ml. for the second ejaculate. The ascorbic acid content in buffalo bull semen was significantly lower than that of hill bull semen.

No significant correlation was found between the seminal ascorbic acid and the quality of semen in both the species. Significant positive correlation was found

between ascorbic acid and fructose content in the semen of hill bulls; in case of affalo bulls this correlation was not significant.

## BACTERIOLOGY

### 0. Bacteriological Study of cow milk.

SATYA RANJAN SARKAR, Haringhata.

Investigations have been carried out on the standard plate count, coliform test and keeping quality test of cow's milk under different conditions of sampling, temperature and humidity. The tests included the standard plate counts performed on samples from the various stages of the process, namely, cooling section, before bottle filling, after bottle filling also from raw milk. Coliform tests and keeping quality tests were also done on the samples of the different stages. The effects of temperature and humidity were recored. The following conclusions have been arrived at. From a comparative study of the bacterial count of the raw milk and milk from the cooling section, (raw milk showing the count varying from 1,50,000 to 25,00,000/c.c., cooling section showing the count varying from 300 to 1,300/c.c.) it was quite evident that the pasteurisation was carried out quite efficiently to reduce the number of bacteria to an enormous extent.

From a study of the bacterial count of the cooling section to bottle filling and thence to sealed bottle (the count of cooling section varying from 300 to 1,300/c.c., bottle filling varying from 1,500 to 15,900/c.c., sealed bottle varying from 4,700 to 22,700/c.c.), it was seen that the count slowly increased starting from the cooling section. It was interesting to note that the trend of increase in bacterial count in the sealed bottle was rather sudden.

### 51. Bacteriological Study of Toned Milk.

SATYA RANJAN SARKAR, Haringhata.

The paper deals with the bacterial count (standard plate count) of toned milk, sampled at different intervals both raw and pasteurised. Tests were carried out on samples kept in the cold storage at an average temperature of 40°F. and pasteurised again in the laboratory by the test tube method.

(1) The standard plate count of the raw sample of toned milk (unpasteurised) was found to vary from 8,50,000 to 31,50,000/c.c., whereas the same after laboratory pasteurisation showed the count varying from 3,500 to 9,200/c.c.

(2) The standard plate count of the pasteurised toned milk (sealed bottle), 1st sample drawn earlier in the day at 2 or 2-30 or 3 p.m. was found to vary from 15,000 to 23,600/c.c., which on re-pasteurisation showed the count varying from 2,100 to 5,000/c.c.

(3) The standard plate count of the pasteurised toned milk (sealed bottle), 2nd sample taken at 3-30 or 4 or 4-30 or 5 p.m. was found to vary from 19,000 to 31,000/c.c., which on re-pasteurisation showed the count varying from 2,700 to 9,100/c.c.

The results showed that the total bacterial count of the pasteurised toned milk was partially due to thermoduric and thermophilic organisms and partly due to contamination from the different sources of the pasteurisation plant. A notable observation was that a sample drawn later in the day showed higher counts than a sample drawn 2 to 2½ hours earlier which was possibly due to the accumulation of bacteria with the running of the machine.



**MISCELLANEOUS****52. Migration and growth of Explanted Tissues from Cancer Cervix by Autologous and Homologous Serum and Plasma Incorporated in the Medium.**

J. CHATTERJEE, Calcutta.

Cancer cervix (3rd stage clinical) cells are being cultured in hanging drop preparation and in the well of the depression slides, in a medium consisting of (i) chick embryo extract, patient's own plasma and patient's serum with 50% Tyrode soln., (ii) chick embryo, extract another patient's serum with 50% Tyrode and another patient's plasma. In the first case with autologous serum and plasma there is increased rate of migration from the explant within 45 hours. This enhanced cell migration from the explant goes on for a period of 4 to 5 days after which there is a standstill. The lateral cell migration from the explant is being measured quantitatively, by drawing the cells in camera lucida in both the cases. Although it would be expected that all cancer cervix patient's plasma and serum would theoretically provide similar growth stimulus to cancer cervix cells, this finding necessitates a closer investigation into the peculiarities in individual plasma or serum with respect to their growth stimulating effect on any particular type or not.

Gilliard has pointed that in a growing chick embryo, that is to be used in the medium, the total nitrogen with the period of incubation, comes to a maximum on the 19th day. By using chick embryo extract from a 8 to 10 day old chick embryo, we are getting the best result so far as both the handling of the materials and growth stimulating properties are concerned. So now as a routine, in the above mentioned experiments we are using chick embryo extracts from 8 to 10 day old chick embryo.

**53. Effects of Infra-red irradiation on spermatogenesis of guineapigs.**

P. B. SEN and A. K. CHOWDHURY, Calcutta.

The susceptibility of the germinal epithelium of testis of mammals to heat has long been proved. The effects of infra-red rays on the spermatogenic epithelia of the testis of guineapigs and the possible mechanisms of their degeneration were studied. The testes of adult male guineapigs were exposed to infra-red rays for a definite period and the animals were sacrificed after varying intervals of rest. Four minutes exposure for three consecutive days proved to be highly toxic and caused almost complete disappearance of germinal cells except some spermatogonia and sartoli cells, within nineteen days rest after the last exposure. The leydig cells were unaffected, while the primary spermatocytes were found to be most affected. The other cells showed different grades of susceptibility to heat rays. In the study of the mechanism of degeneration the succinic dehydrogenase and alkaline phosphatase activities were not found to be significantly changed. The nucleic acid cycle was found to be most affected and possibly the failure of conversion of ribo-nucleic acid to desoxyribonucleic acid is an important factor responsible for degeneration. Thyroxin was found to give a remarkable protection to the germinal epithelium against infra-red irradiation.

**54. Quality of Liver Injections.**B. N. CHOWDHURI, N. K. IYENGAR, M. D. CHAKRAVARTI and  
S. BHATTACHARYA, Calcutta.

Clinical evaluation of liver injection in Addisonian pernicious anaemia cases is the official therapeutic test prescribed in U.S.P. There is no reliable alternative

laboratory method though estimation of vitamin B<sub>12</sub> content is a near approach. Having alone potency, lack of uniformity of quality of liver injections from different sources as noticed from differences in physical, biochemical and pharmacological characters has been observed. The occurrence of reactions in patients with certain brands of liver injection confirms this lack of uniformity and this laboratory undertook to investigate into the possible factors responsible for such reactions and to devise tests by which samples producing such reaction could be detected. These tests include those for undue toxicity, histamine-like substances pyrogen test and limit for protein nitrogen. A critical evaluation of reliability of different samples by these tests has been done.

#### **A method for the determination of free and Total Cholesterol in blood and tissues.**

SAILEN MOOKERJEE and D. P. SADHU, Nagpur and Calcutta.

On the basis of Schoenheimer and Sperry's method for the determination of cholesterol after digitonin precipitation, a revised method has been evolved for the determination of free and total cholesterol in blood and tissues. Factors which influence color development in acetic acid solution of cholesterol with particular reference to time and temperature have been studied. Requirement of amount of digitonin for complete precipitation under different conditions of time, temperature has also been studied.

Conditions for saponification to obtain total cholesterol values are studied and definite relationship between the volume of acetic acid for dissolving the cholesterol-digitonide precipitate and color intensity is established.

Finally the revised method has been stated and data with the average values free and total cholesterol of blood, liver, kidney, intestine and adrenal glands of rats are presented.

#### **Seasonal variations in the Physiological reactions in normal sheep.**

P. N. MEHROTRA and D. N. MULLICK, Izatnagar, U.P.

The important applications of the climatology in the health and productive efficiency of cattle and buffaloes were investigated in these laboratories. It has been definitely established that climatic factors of the place played an equal part with heredity, nutrition, disease control and management in maintaining the efficiency of optimum productive capacity of the animals.

In the present observation, ten healthy adult male sheep were selected for recording pulse rate, respiration rate and body temperature weekly for all the seasons, throughout the year. Dry bulb temperature and relative humidity were also recorded.

The air temperature and relative humidity were 65°F., 77% and 105°F., 35% in January and June respectively. The mean pulse rate, respiration rate and body temperature in these periods were 59, 25, 102.4°F. and 64, 33, 102.5°F. respectively. The percentage increase in the physiological reactions in summer months were 9 and 32 for pulse and respiration rates.

The changes of the physiological behaviours, showed positive relations with increase in the air temperature. The respiratory rate showed highest correlation. The pulse rate and body temperature varied little with the rise of air temperature. The data were shown in tables and charts.



**57. Staining of Thyroid by Masson's Trichrome.****BHUBON MOHAN ROICHAUDHURI, Calcutta.**

A little modification of the modified Masson's Trichromatic method was found suitable for bringing out the histological details of both the nucleus and the cytoplasm with the maximum possible differentiation and the minimum possible time. Bouin-fixed sections were stained with the following procedure:—

(1) The sections are deparaffinised and washed in running tap-water for 1 minute.

(2) Sections are stained with Harris' haematoxyline for 30 seconds and then placed in a jar under tap for 3-4 minutes.

(3) Mordanting with 5% double acid mixture (equal parts of 5% phosphotungstic and phosphomolybdic acids) is carried on for 1 minute and then a short rinsing with aq. dist. for about 30 seconds.

(4) Then the sections are stained with warmed triple stain-acid mixture for 3-4 minutes. The triple stain-acid mixture is made up as follows:

Biebrich scarlet acid Fuchsin ...	...	...	40 cc.
2% Aq. Orange G solution (Hollborn) ...	...	...	40 cc.
3% acetic acid ...	...	...	20 cc.

The Biebrich scarlet acid Fuchsin is prepared in the following way:

2% Biebrich scarlet (Aq.) ...	...	...	8 parts
2% Acid Fuchsin (Aq.) ...	...	...	2 parts

(5) Remordanting with the double acid mixtures is made for 1 minute.

(6) Then after a short rinse, the sections are stained with 10% aq. aniline blue for 3 minutes.

(7) Differentiation with 3% acetic acid is carried out for 2 minutes.

(8) Lastly the sections are dehydrated (alcohol, acetone, acetone-exylol and xylol) and mounted as usual.

## SECTION OF PSYCHOLOGY & EDUCATIONAL SCIENCES

*President*—DR. RAJ NARAIN

### *Abstracts*

#### 1. **Some Important Psychological Apparatus.**

K. P. BHAGHAT, Poona.

These days import of Psychological Apparatus is difficult and dear. Hence an effort was made to design and manufacture it locally.

*Electronic Chronoscope* : Measures time in hundredth of a second for fifty cycles. Can be used as a Cumulative Timer and D.C. Impulse Counter. Will measure in milliseconds with a higher frequency source.

*Audiometer* : Threshold sensitivity at different frequencies and other auditory phenomena can be demonstrated.

*Time Sense Apparatus* : An apparatus for Reproduction and Estimation of filled and empty time intervals.

*Memory Drum* : Exposure time .5 to 3 seconds. Two 8" x 26" papers, one for double spaced typewritten matter and other for figures etc. are used.

*Ergograph* : An instrument constructed to record on a kymograph, with a special stabilising arrangement.

*Impulse Counter* : Successfully made by detaching the digit train from a special revolution counter.

*Miscellaneous* : In addition, Yerke's multiple Choice Apparatus, R-T Apparatus, Hubert's diaphragm, Watson's Apparatus, Pursuit Meter, Cumulative Timer, Brightness Discrimination Apparatus, Brightness Constancy Apparatus, Variable path Electric Maze, Tachistoscopes etc. were locally manufactured. A four pen Polygraph and an Electronic Voice Key are being attempted.

#### 2. **An Electrical 'Reaction Time' Apparatus.**

N. L. DOSAJH, Jullundur.

The Electrical 'Reaction Time' apparatus described here consists of a board with a rotating drum (which can be driven by a Kymograph) and a partition screen fixed on it. The screen holds two bulbs, one red and the other green, for choice reaction. When the experimenter presses his key, a mark is made on the rotating drum through an electro-magnet fixed by the side of the drum. And when the subject responds by pressing his own key another mark is made on the rotating drum. The whole system is working with the help of a number of batteries provided in the base. A spring time marker or an electro-magnet time-marker can be adjusted separately on the drum in order to know the speed of the drum.

This apparatus is specially suited for experiments on reaction time and as one of the tests for the selection of pilots, motor drivers, railway engine drivers and other personnel where quickness in hand and eye-coordination is required. It has been prepared by Psychological and Physiological Apparatus Manufacturing Co., Hasan Ganj, Fyzabad Road, Lucknow to my specifications, and is being used in the laboratory of psychology at Government Training College, Jullundur.



**3. Space Errors in Relation to Manuscript Slant.**

M. VARMA, Nagpur.

In January 1952, the author published in the Indian Journal of Educational Research 'An Experimental Study of Manuscript Slant' which employed with marginal and linear slants a number of visual estimation variables including vertical and horizontal space errors. In the first centroid factor a contrary relation appeared between marginal slant and horizontal space error and draughtmanship showed no bearing on slant tendencies. In the present research the variables were positively directed by the addition of a constant and gross measures were used after the data had been inspected for the assumption of linearity of relation. Three factors were extracted for a six variable matrix and the results of oblique and orthogonal rotations compared. Interpretation indicated the presence of a tendency to be consistent in visual estimates and another for overestimation in a given direction. The first factor was too general and in rotation showed a relation between a left-ward swing of the margin and consistency below the line of fixation. The second factor revealed that for inward swing of margin this consistency should be accompanied by magnification of distances above the line of vision. In the third factor the downward slant of lines implied magnification on the left and consistency on the right. The research therefore establishes an unexpected relationship between orders of slants and visual space errors which can bear further investigation.

**4. An aspect of the Problem of Perception.**

N. S. N. SASTRY, Bangalore.

In this paper an attempt has been made to trace the development of perception in the evolutionary trend; the approach has been mathematical. An experimental programme inquiring into the origination of perception has been described and the specific problems have been enumerated.

**5. Assessing General Intelligence of Children from a Short Interview.**

S. M. MOHSIN, Patna.

A group of 180 children, 10 to 12 years of age, were interviewed by the writer, for about five minutes each, on the average. Their intelligence was rated at the termination of the interview, in each case, on a seven-point scale.

The children were also administered thoroughly standardised verbal and non-verbal tests of intelligence of completely different types. The correlation between the two tests was very high which proved their high validity as measures of the general intellective factor.

Chi-square test of independence was used. Very highly significant relationship was found between the ratings and each of the two types of test scores. The confidence level was higher than .01.

The results were contrary to the general conception that subjective rating of intelligence is thoroughly unreliable. If the interviewer has a clear notion of the qualities of behaviour that are marks of intelligence, his assessment may not go amiss. The error has been generally due to the influence on the interviewer of irrelevant factors, *viz.* those that are not really associated with the function of intelligence. Moreover, the interview situation has not been made as facile and homely for the interviewee as it should be.

**Defence Against Ego-threat in Self-judgment—A Factorial Study.**

S. M. MOHSIN, Patna.

The validity of self-judgements depends upon accuracy of self-observation and correctness of recall. Vast literature has accumulated on the dynamics of selective perception and selective memory, and ample light has been thrown on the defence against ego-threat as a factor therein. But little work has been reported on the defensive function of observation and memory as forming the basis of one's judgement regarding his own feelings, attitudes, thoughts and behaviour in a hypothetical or about-to-be real situation.

A hypothesis was formed regarding two major variables : (a) denial or repudiation and (b) substitution or compensation, that operate as defenses against ego-threat in self-judgment. Self-ratings were obtained from a group of college students on several sets of verbally portrayed situations and common personality characteristics that were so selected as most likely to work up the hypothesised defenses. As a check, an intelligence test and rating others on common traits were so introduced.

A correlation study of the results was made for the purpose of factor-analysis. A bipolar factor of repudiation-substitution emerged very conspicuously. Besides, two other factors were also indicated : (a) insight or capacity for self-objectification; (b) reticence-indiscretion. The latter characterised not only self-judgment but also judgment on others' traits and behaviour.

**7. A study of the 'Erfassungstypus' in the Rorschach Test.**

H. S. ASTHANA, Lucknow.

The paper reports a study of the erfassungstypus of 24 Indian Rorschach test records of normal adults. The paper works out the expectancy of the location categories, and tests the distribution with Chi-square test. Curve fitting and goodness of fit are worked out. The data are compared with similar findings of the western Rorschach workers.

**8. Some Configural Analysis of Rorschach Scores.**

H. S. ASTHANA, Lucknow.

Analysis of patterns in psychological measurements is probably the only solution to the study of configurational character of personality. The real problem in all such investigations is the identification of a psychological *pattern* and the assessing of the *consistency* with which this pattern is adhered to by the group members. The paper indicates the different solutions which could be attempted. It works out one solution of the problem on a set of Rorschach scores by using the concept of generalized distance as proposed by Cronbach. The paper presents the findings by this method.

**9. Rorschach Pattern of a Group of Normal Adults.**

Mrs. MYRA KUMAR, Ranchi.

The present piece of work is part of a bigger research programme, a study of the Rorschach variables indicating intellectual level and emotionality.

This paper deals with the Rorschach findings of 20 medical students, of high intellectual level, as indicated by their Matric results.

The Rorschach variables indicating only the higher level of intelligence have been discussed, and the data compared with other studies on the same line. The following are the results.



The present group gave a good number of W, and high W%; approach mainly W-D; the sequence mostly rigid; High I%; fairly high orig% and Z score; and good number of P. All these conform to their good intelligence. But they gave unexpectedly few M and low R; and their A% was also high. This may be partly due to their inhibition, which has affected some other variables as well, *e.g.* sum C. For low M and R the cultural setting of the group may be to some extent responsible.

The number of the cases studied here is too small to lead to any conclusive result, which may be taken as tentative.

#### 10. The Manual Ability of the Kanikkars of Travancore.

P. C. RAY, Calcutta.

By the end of the year 1948, a party from the Department of Anthropology and under the general direction of Dr. B. S. Guha, started a systematic survey of the aboriginals in the Travancore State. This report deals with the manual ability of the Kanikkars as revealed from the test known as Crockett. The subjects tested were all adult males, numbering 99 and between 20 to 40 years of age.

The results may be summarised as follows :

- (1) Considering the circumstances in which the test was applied, the test may be regarded as reliable.
- (2) The sub-tests seem to be largely influenced by specific factors, and
- (3) The Kanikkars and the American boys show differences in manual ability in the context of the test measurement.

#### 11. Measurement of Social Distances in Society and Industry.

N. S. N. SASTRY, Bangalore.

Society is an interrelated system of social groups. The phenomenon of group formation induces in each individual member of a group a mental attitude, conditioning his outlook and conducts. The present study is a study in attitudes. On the basis of Bogardus Social Distance Scale, a finer scale was evolved and a group of Gujarati teachers was tested in regard to their group identification and social distances kept between various groups in India. The data has been analysed.

The paper also presents an appreciation of the phenomenon of industrial group-formation and inter-group tension. The psychological factors in human relations are stressed. The need for investigation in the field is pointed out. The fact finding schedule that has been prepared for a preview of the field is described and the hypotheses in view enumerated.

#### 12. Attitudes of University students towards some Politico-Economic issues.

Dr. R. RATH, Cuttack.

The attitudes of about 800 University students of Orissa towards 16 important Politico-economic issues were measured on a five point scale. The distribution of test scores was calculated and its significance examined with the help of Chi-square test. The findings prove the significance of distribution of test scores and thus indicate a significant trend of opinion. The scores were also graphically presented by means of histograms and a detailed study of shapes and social implications of such curves was attempted.

The subjects were grouped separately under three occupational heads such as cultivation, business and services and three economic heads representing three distinct economic strata. In determining this the occupation and economic status of their families were taken into consideration. Occupation and economic status of families do not seem to have any influence on the attitudes of students.

### 3. Psychology of Hysteria.

Dr. N. N. CHATTERJI, Calcutta.

Hysteria is a psychoneurotic disorder and it usually manifests itself in two main forms, *viz.*, anxiety hysteria and conversion hysteria. In the present paper I want to communicate the psychoanalytical findings of two cases of conversion hysteria and as one of them later on developed symptoms of schizophrenia tried to find out the link between hysteria and schizophrenia. In both the cases the inverted oedipus complex was found in the unconscious and the homosexual tendency that was noticed was not of genital masculine type but was created as a result of identification with the phallic mother or the milk giving mother and the father appeared as a rival to the mother's love. Both also expressed a sense of oral frustration to the effect that they did not get enough milk from their mother and held their father responsible for it. In connection with both the situations oral aggressive ideas were expressed towards father but they feared that their father would force them to go to their mother's womb and get merged with her so that they would be transformed into a female. Their hysterical fits were a symbol of being inside the mother's womb and the termination of the fit meant their liberation from this condition. When one of these cases developed schizophrenia, she stopped getting hysterical fits but complained that she was within the mother's body and gradually became dull and apathetic. Later on she became communicative but aggressive and her aggression was directed towards women who were supposed to be her enemies. She also said that her clothes were her mother's body and by tearing them she would think that she had been liberated from her womb. So it would be noticed that the phantasy that created hysterical fits though unconscious became conscious in schizophrenia and affected her reality sense.

### 4. Juvenile Crime and Intelligence.

UDAY SHANKER, Delhi.

The study reported here is based on the results of application of C. H. Rice's Hindustani Binet Performance Point Scale to 140 male Juvenile delinquents in the District Jail and the children's Home in Delhi. The purpose was to find out how intelligence and delinquent behaviour were related and also to see if specific crimes had any relationship with the level of intelligence of the offenders.

The investigation revealed that only 17% delinquents had an I.Q. above 100 and 27.4% of the cases had I.Q. below 70 who could be called mental defectives. The average I.Q. of the delinquent group was found to be 83 ranging from 40 to 122. This indicated that the great majority of the delinquents were dull rather than defectives. There were, however, 25.2% of the delinquents of normal intelligence, and there were some of superior and very superior mental level in the order of 6% and 1.5% respectively. These findings support the view that there is no direct causal relationship between delinquency and intelligence. Normal or high intelligence is no guarantee for good behaviour.

There was found to be some indication that a person with a low I.Q. would commit a simple offence when a person with a high I.Q. will not be afraid of committing major crimes; yet, on the whole, the classification of delinquent acts in relation to I.Q. has little significance.

### 15. The factor of understanding in the judgment of literary passages in a Prestige-suggestion experiment.

J. P. DAS and R. RATH, Cuttack.

An attempt is made in this paper to see the effect of understanding on suggestibility due to prestige, while judging poetry passages. Three groups, each



having 10 Ss. were used; one of them as the control, and the other two as experimental groups. One of the experimental groups was given instructions in a manner by which a critical attitude would be induced. The control group was asked to rank poetry passages in two sessions; but the experimental groups were asked to rank some names of familiar poets besides the poetry passages given to the control group in one session, and in the next session, each of those poetry passages was attached to the name of a poet who had already been ranked.

It was found that the critical group in which a factor of understanding worked, showed significantly less shifts in their judgments than the other experimental group. However prestige was found to be a much stronger factor than understanding.

#### 16. Problems of standard with special reference to examination.

NIROD MUKHERJI, Gauhati.

The term standard as employed in education possesses varying significance, causing frequent confusion in its unguarded usage. An attempt therefore has been made in this paper to clarify the meaning of this expression with particular reference to examination. The criteria in the ascertaining of standard have been sorted out. Furthermore, a tentative formula has been suggested to derive an index of the standard. This index may be profitably used in the comparative evaluation of standards, amongst the examining bodies.

#### 17. Replacement of English by the Regional Languages as Medium of Instruction of Science in the Colleges.

BASANTA KUMAR BEHURA, Cuttack.

Uttar Pradesh (1951) and Orissa (1954) have respectively accepted Hindi and Oriya as the State language, and other State Governments have undertaken similar measures for introducing the regional languages for official purposes. Many Universities have introduced regional languages as the medium of instruction of science at the I.Sc. and B.Sc. stages with the goal of ultimately switching over to it at the Post-Graduate stage in all the Faculties. A detailed scheme is given for the systematic replacement of English by the regional languages as the medium of instruction of science in the colleges from the Intermediate to the Post-Graduate stage. If the work is started in 1955, English can completely be replaced at the M.Sc. stage in 1965 *i.e.*, within eleven years. Problems like the fate of college teachers not knowing the regional languages, compilation of *parivasa* dictionaries and scientific text-books in Indian vernaculars have been discussed. While advocating the change of medium of instruction from English to regional languages, it is proposed to make it compulsory for M.Sc. students to gain sufficient proficiency to understand and write scientific literature in English. *Parivasas* and text-books in Indian vernaculars should be published by the State Governments and Universities and the compilers amply rewarded.

#### 18. Comparative Study of Interests in Professions and College-Subjects.

R. G. CHATTERJEE and D. BANERJEE, Calcutta.

The present study attempts to find out the relationship between the "Choice of College-Subjects" and "Choice of Occupations". In all about 100 students of different Calcutta colleges studying Science, Arts, Medicine, Technology, etc., acted as subjects. There were 19 occupations and 18 college-subjects in the list. Each student was required to put either A, B, C or D according as he liked or

liked most the particular item in the list. Contrary to the general notion, it is found that, Science students had a liking for the subject "Literature" and the occupation "Artist". The highest percentage of "Liking" and "Disliking" in regard to these items has appeared in the age-group 21-23 years.

#### 9. Reliability and Validity of School Examinations.

A. K. GAYEN, Kharagpur.

For measuring the reliability of psychological tests a number of formulae are available; but the conditions required for most of the coefficients are not usually obtained in cases of School examinations. One of the measures, namely the Split-half formula, appears to have a larger scope, as it may be possible to construct a half-test by combining a group of questions in one part and the rest in the other. The question paper provides for a maximum mark of one hundred, the value of questions in each part should be fifty. This study considers an example and reports results from various possible approaches. The first half-test consists of 25 items carrying five marks each. Hoyt's method of analysis of variance has been followed to obtain the reliability coefficient for the full test. Some external criterion being made available here, the validity of the examination paper has been estimated. Considering results of all the different approaches, a reliability coefficient of approximately 0.6 and a validity coefficient of about 0.5, are obtained for the examination paper.

#### 10. Predicting Success in Colleges.

F. S. CHOTHIA, Bombay.

With the dual object of establishing the validity of certain psychological tests and devising a system of selecting students according to their aptitude, the Vocational Guidance Bureau of the Government of Bombay has launched a number of experimental studies in different types of colleges and institutions of higher learning. To date such studies have been initiated in an engineering college, a college of architecture, a medical college, a commerce college, a school of applied art, and three science colleges. To the new entrants in the first year a battery of psychological tests is given and then these tests results (as well as the marks on the basis of which candidates were admitted) were correlated with the final examination marks each year. Taking all the factors into account, multiple correlations were found with the criterion of success. In all cases where such correlations have been worked out, it has been demonstrated that the tests plus the usual entrance criterion gives a much better prediction of future success than the entrance criterion alone.

#### 11. Analysis of Common Errors in Algebra by Students of Class X.

PRATIBHA DEO, Lucknow.

280 students of five different schools of Lucknow were tested to find out the common errors in algebra. A test was devised on the basis of errors from 200 answer books of the annual examination of Class IX. The errors were classified into six fundamental categories: (i) Concept, (ii) Sign, (iii) Index, (iv) Substitution, (v) not reducing to lowest form and (vi) reasoning. The test result shows that by far the largest percentage of errors is of concept followed by mistakes of other types. Increased experience and greater practice reduces the errors of indices and of substitution but conceptual errors not only persist but increase owing to lack of remedial teaching at the right moment.



Besides school conditions, such as, methods of teaching, change of teachers and others, personal factors, such as, ill health, excitement, intra-family relationships, are also responsible for the above mentioned errors.

## **22. A further Analysis of Relation of Union-membership to Attitude of Industrial Workers.**

HARISH CHANDRA GANGULI, Kharagpur.

An attitude survey was conducted of 380 randomly selected workers from a premier light engineering factory of Calcutta. Of the different factors influencing the attitude of the workers towards the company and different aspects of the job situation, the membership of the factory union, strongly leftist in views and unrecognised by the company, was found to be the most important. The union group responds differently from the non-union group primarily in respect of those items that refer to the general policies of the management, of supervision etc. than to items that refer specifically to special aspects of these. The former are more thorough expressions of what Roethlisberger, and Dickson call 'the logic of sentiments'.

A factor analysis of those items only over which the two groups differ significantly was undertaken by Hotelling's method of principal components. Only one common factor could be extracted, all items being significantly saturated with it. This has led to the postulation of a general pro- or anti-company attitude factor, which is very similar to what Likert refers to as the contented-discontented attitude factor. Such a pro- or anti-company attitude seems to depend largely on the emotional conviction of the worker that he will be able to satisfy his needs through the particular employment relationship. The anti-company union is developing a discontented attitude among its members by undermining this confidence of them in the institution.

## **23. A study of Job Satisfaction in Office and Manual Workers.**

DURGANAND SINHA and KAILASH CHANDRA PRASAD, Patna.

An investigation was made into factors that underlie satisfaction or dissatisfaction in work by comparing groups of manual and office workers. By questioning the workers whether they were satisfied or dissatisfied with their work, the subjects were divided into the Satisfied and Dissatisfied Groups. There were fifty manual and fifty office workers in the former group, and the same number in the latter group. These subjects filled in a questionnaire individually and checked the items that they thought were responsible for their being satisfied or dissatisfied with the work. The frequency with which each factor had been mentioned was calculated, and ranked in order of frequency.

There was considerable agreement in the groups of manual and office workers as to the factors underlying satisfaction. The rank difference correlation was found to be 0.60. Interesting work, social status, good supervisor, good company to work for, and work according to health were the first five factors behind satisfaction. In the manual workers, the first five factors were boss, interesting work, fellow workers, work according to health, and job according to ability.

Analysis of data was also made on the basis of age, length of tenure and size of family.

In the dissatisfied group, the factors underlying dissatisfaction as mentioned by 50 office workers were, in order of frequency, salary, not enough leave, no visible results, no competition, and hurts ego, whereas in the pity manual workers, the order was salary, no security of job, no advancement, not enough leave, and

work not according to health. The rank correlation between the office and manual workers groups was 0.804.

It is to be noted that salary, leave, security, and advancement came to the fore and were mentioned as chief factors behind dissatisfaction, whereas they were ranked low with respect to satisfaction.

The study on the whole stresses the importance of non-financial factors behind dissatisfaction in work.

#### **1. Training Within Industry—Baroda Project.**

L. J. BHATT and P. C. AMIN, Baroda.

The object of this paper is to report the results of a programme of training within industry conducted under the auspices of the M. S. University of Baroda and the Gujarat Federation of Mills and Industries. This programme is designed to improve skills in supervisory functions,—particularly, the skill in improving methods, the skill in handling people and skill in instructing. The advice of L.O. expert in India was available for the programme and the whole programme was conducted through Institute Training of Officers and later through conference—discussion groups by the officers in various industries like Textiles, Chemicals, Glass, engineering and minor industries. In this paper, the Baroda project in a group of industries is explained and the results achieved summarised.



## SECTION OF ENGINEERING AND METALLURGY

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### *Abstracts*

#### **1. Fine Crushing of Coal in Ball Mill.**

B. C. DUTTA and S. K. NANDI, Kharagpur.

The effect of speed of rotation on the efficiency of grinding of coal was studied in a Ball Mill, 8 inch diameter  $\times$  8½ inch length, filled with 100 one inch Steel Balls and operated at four different speeds.

1000 gms. of bituminous coal, having a Ball Mill grindability Index of 77.2 and size range 3/16—1/8 inch, were crushed for 15, 30 and 60 minutes. Ratio of volume of material charged to void volume was 1.8 : 1.

The product was sieved mechanically in B.S.I. test sieves 10 to 300 mesh.

Area under the Curve-Cumulative per cent undersize versus Reciprocal of size—gave surface created.

Results showed that when the crushing period was 15 minutes, surfaces created were 14, 26.4, 27.5 and 30 sq. cm. at 23, 43, 63 and 83% critical speeds.

The corresponding figures for 30 minutes crushing were 24.5, 32.7, 34.2 and 30.8 and those for 60 minutes crushing were 34.4, 36.1, 37.9 and 36.2 sq. cms. respectively. Maximum increase in surface was obtained when the speed was increased from 23 to 43%. At 63% speed the increase in surface was very small and at 83%, the surface developed was generally less than that at 63%.

The best speed where maximum energy was utilised, was found to be 43%.

#### **2. Pressure Drop in Heat Exchangers.**

D. VENKATESWARLU, Kharagpur.

Heat exchangers are widely used in the power and process industries but there are no accurate methods for predicting the pressure drops for the tube-side and shell-side fluids passing through an exchanger. Determination of these pressure drops is necessary in design work in order to calculate pump power requirements and to be assured of the required fluid flows if the units are to work under vacuum or with gravity flow. The tube-side pressure drop can be predicted with fairly reasonable certainty but the shell-side pressure drop determination presents considerable difficulties due to uncertain flow pattern because of the possible wide variations in tube spacing and tube arrangement, baffle design and baffle spacing, leakage through clearances and nonisothermal flow conditions.

In this paper, the components constituting the total pressure drop are itemised and the component pressure drops are individually considered. The effect of design variables on pressure drop is discussed. The conclusions of the recent investigations on flow of fluids across tube banks are presented. Simplified equations suitable for design and trial-and-error solutions are given.

#### **3. Submerged Combustion.**

D. VENKATESWARLU and I. B. GULATI, Kharagpur.

Submerged combustion is the burning of a fuel within the body of a liquid for heating or evaporating the liquid by direct contact with the combustion gases.

sence of intermediate heat transfer surface and scale or dirt films is the principal advantage of heat transfer by submerged combustion as compared to convective heat transfer. Besides it provides good mixing and high heat flux. In industrial practice submerged combustion is for heat transfer under conditions of severe corrosion or scale formation as for heating pickling baths in the steel industry or concentration of solutions of inverted solubility. It is also extensively employed in heating highly viscous solutions and solid-liquid suspensions.

This paper reviews the development of submerged combustion. The construction and working of different types of burners is described and the advantages and industrial applications of the process are critically discussed.

### **Boundary Correction of Mohr's Theory on Cohesive Soil and its Application to the Problem of Retaining Wall. III.**

S. P. BAIDYA, Maithon.

Further to my paper (Part III of Proc. Indian Science Congress, 1953 and 1954) may be pointed out that within the depth of critical height a cohesive backfill remains in elastic equilibrium while below this height, it changes to plastic equilibrium, provided the deformation is free from reaction due to external stress. Development of maximum pressure on a retaining wall depends on the time lag at the plastic mass require to adjust itself in the changed condition. Since the mass fails internally wall friction has no effect on the direction of resultant pressure which is normal to the surface of the wall. This signify the validity of Rankine's theory and has been actually observed during excavation of "Foundation at Poole Power Station" at Holes Bay Poole, Dorset. If however the deformation is obstructed by the rigid confinement as is done by prestressed bracing in a coffer dam or in an open cut, the cohesive back fill suffers elastic failure, the mass behind the bracing behaves like rigid body causing a change in the direction of resultant pressure due to wall friction. This signify the validity of General Wedge theory of Dr. Terzaghi, as observed during "Pressure measurement in open cut contract D-8 Chicago Subway".

### **Statistical Quality Control and its use in Engineering Concerns.**

S. B. CHAUDHURI, Calcutta.

The present paper discusses the scope of the subject of Statistical Quality Control in Engineering Industries. It describes how Statistical Quality Control can have very successful application in industrial concerns. Two particular industries, namely, Printing Press and Textile Manufactures have been considered specially in this connection.

### **A Special Technique of Relaxation Methods in Simultaneous Equation.**

G. BANDYOPADHYAY and R. K. NARASIMHAN, Kharagpur.

In this note a special type of group has been suggested which keeps particular residue or residues to zero or any other fixed value while affecting other residues. This method appears to give quicker results at least in some cases. The convergence is sure. The analytic or algebraic aspect of the method has also been studied at the suggestion of Dr. S. R. Sengupta.



**7. "Correlation analysis between temperatures of water from Upper Ganga Canal near Bahadradab and water from Pathri Power House Pits".**

A. P. BHATTACHARYA, Roorkee.

In connection with the construction of a new Power House at Pathri (near Roorkee), a number of pits were in operation for the dewatering and lowering of the ground water table. The pits were about 2 furlongs distant from the Upper Ganga Canal. It was necessary to have some idea as to whether any seepage was taking place in the water from Pathri Power House pits from the Upper Ganga Canal, because the detection of a heavy seepage might have necessitated the modification of some of the constructional aspects of the foundation of the Power House.

A significant correlation was detected between the temperatures of water from two sources and so the possibility of seepage from the Canal could not be ruled out.

**8. Fluid Property of Non-Coherent Granular Mass.**

S. P. BAIDYA, Maithon.

Non-coherent mass like dry sand remains in plastic equilibrium under horizontal surface and therefore flows in unconfined condition under its effective weight unless the flow is checked by the resistance produced by failure of sand along the edge in the form of slope. The sand mass within the slope behaves as retaining wall and is subjected to horizontal thrust by the rest which remains undisturbed under the original horizontal level. An equilibrium is reached between these two forces when slope angle is equal to the angle of internal friction. This has been observed during laboratory experiment with dry sand. Size and density having same slope angle is zero for perfectly smooth surface of the grain in otherwards the mass flows unchecked. If however, the internal friction be maximum effective weight is minimum resulting thrust to be minimum. Angle of internal friction having same, lighter mass will have smaller thrust and steeper slope.

**9. The Engineering Properties of a Loam Soil of West Bengal effect of Base Saturation with Aluminium.**

B. CHATTERJEE, Sibpur.

In continuation of the work on the engineering properties of Indian soils, some simple tests such as, measurements of grading, apparent density, moisture content at saturation, pore space, specific gravity, volume expansion, field moisture equivalent, shrinkage limit, shrinkage ratio, permeability, lower liquid limit, plastic limit and plasticity index, have been made with disturbed samples of a soil collected from Sibpore (Howrah). Similar tests have also been made with the same soil after saturating it with aluminium. A comparison of these results with the range of numerical values of the physical constants of different groups of soil, suggests that the soil under consideration belongs to the A-5 group as classified by Brown and Hogentogler (*Roads and Streets*, 81, No. 3, 1938). The observed properties of this soil indicate that it should be avoided, if possible, for any engineering enterprise. Slight changes in the values of the physical constants were brought about by replacing the exchangeable bases with aluminium excepting that the coefficient of permeability and volume expansion were found to be lower in the aluminium saturated soil. The treated soil was also found to show higher plasticity, index and water stability compared to the untreated soil.

**1. Stabilized Soil Blocks for the Protection of Clay Bank against Wave Action.**

K. P. SHUKLA and R. P. SRIVASTAVA, Roorkee.

Since long experiments were in progress to utilize a mixture of small quantities of cement with soil to make sufficiently strong blocks to prevent erosion of clay banks. Increasing quantities of cement from 1% to 15% were mixed with soil and compacted to maximum density at optimum moisture in  $2' \times 2' \times 1\frac{1}{2}''$  blocks. These blocks were cured in humid atmosphere for 7 days and subjected to alternate wetting and drying tests. The usual brushing test was also carried out. After these tests were done each block was subjected to strong jets of water for several days and the strength of each noted every day. They were then placed on the sides of channel below a 6 feet so that they may be tried on severe wave action. It was noticed that a mixture of 5% and more of cement gave satisfactory strength as there was no disintegration with all these treatments.

A similar trial was made for the protection of 15 miles levee on Ganges near village Ushehat where they proved quite suitable for number of years.

Other experiments on use of 5% cement soil mixture on make cheap walls of mud houses have given encouraging results. It has been observed that for requisite strength the cement required is far less when a direct electric current is passed through the soil cement blocks.

**1. Staunching of Canals.**

K. P. SHUKLA and C. M. PANT,

In continuation to the research on sodium carbonate method of lining canal bed for minimising seepage losses (Proceedings Indian Science Congress, 1940, 1941, 1942, 1943 and 1944), small scale field experiments were undertaken to compare the adaptability of different kinds of linings to suit different hydraulic and soil conditions. The experimental channels were 250 ft. long. They were constructed of made of earth in standard section in vogue in the province. A water depth of  $1\frac{1}{2}'$  could be maintained in each. The materials that were tried were soil Cement mixture, bricks, sodium carbonate, Bitumen and concrete. These are the materials which are in common use in tube well and other channels. A 5% cement and soil mixture was laid in situ at optimum moisture and maximum density; bricks were laid with 1:4 cement sand mortar with pointings in 1:2; sodium carbonate mixture in proportion of 6% by weight of soil was laid in one inch thickness and one foot below the bed and sides of the channel; Bitumenous tar felt patented by Shalimar Tar Products was laid with joints filled in by Mastic 80; 1:1½:3 concrete in 2 inch thickness was laid on the surface.

Losses were observed continuously for about a year and are proposed to continue for few years.

The results indicate the lining material in order of efficiency are :

Concrete, sodium carbonate, bricks, bitumenous tarfelt and 5% soil cement mixture. This is the order of durability also.

**2. Testing of Building Stones.**

N. K. PATWARDHAN, Roorkee.

Stone has been used as a building material from times immemorial. Since it is used mostly for the construction of monumental buildings which are desired to last for several decades, it is essential to make a proper selection of stones. In addition to the strength test and physico-chemical properties, crystallisation test is also performed. These tests give an indication of the durability of the building stone.



The Indian Standards Institution, in collaboration with this Institute has drafted specifications for various tests on building stones. Some of these tests have been described in this paper.

### **13. "Study of the effects of pumping by tube wells in Doabs west of the Ganga River".**

A. P. BHATTACHARYA, Roorkee.

A study was taken up regarding the effects of tubewells pumping on ground water table for five doabs west of the Ganga River in western U.P. An analysis of variance was carried out for each doab wherein the effects of pumping and rainfall on the fluctuations of ground water table were examined separately. The idea was to ensure that the existing rate of pumping was not exceeding safe limits of extraction and thus not likely to cause a permanent depletion of the ground water table for that would mean the eventual non-availability of drinking water from village wells besides the sinking of heavier capital by necessitating the deepening of the existing tubewells.

It was found that the effects of pumping were not being felt significantly on the fluctuations of ground water table in any of the Doabs, although there was a considerable difference in the degree of insignificance. The extreme importance of local rainfall within a Doab in maintaining the dynamic equilibrium of the ground water table in spite of the introduction of a draft caused by tube well pumping was brought out to some extent in the analysis.

### **14. Silting of Reservoirs.**

N. K. BOSE, Calcutta.

In this report the author has described a number of investigations that are now being carried out under him in connection with the silting of reservoirs. The life of the various reservoirs that are being constructed now for the different multi-purpose river valley projects has been calculated and the lines on which these calculations should be carried out have also been indicated. It has been long recognised that soil erosion which is the source of all sediment is a serious menace to the agricultural prosperity of a country. But so long as the pressure of population on land was not excessive people had been indifferent to the inroads of soil erosion on the fertility of the agricultural fields. Soil erosion has been looked upon as the necessary evil to follow in the footsteps of industrial developments and the progress of civilisation of a country. So long as this was within limits, not much serious consequences were anticipated. As a matter of fact, the land building activity of the soil erosion phenomenon was taken on its credit side and no very serious efforts had been made to keep the phenomenon under control. Indiscriminate felling of trees, removal of the vegetation of cover on hill sides, uncontrolled grazing of sheep and cattle on forest lands did not attract anybody's serious attention. The destruction caused by forest fire started by jhooming or by carelessly thrown cigarette end by a shepherd boy could often be very wide-spread and caused extensive land slides during the next rainy season. No body connected these happenings of the head water regions of the river with the several increasing devastating floods in the lower reach. Perhaps it was never thought of; the beneficial effects of floods by way of better crops or better sanitation more often offset the sufferings following in the wake of severe devastation. In any case, soil erosion was never looked upon as a serious menace to the prosperity and advancement of a country till river controlled works were undertaken for irrigation, navigation and power generation. As soon as man wanted to draw water from rivers by controlled works or use the water for transport or generation of hydro-

electricity, the drawbacks of the sediment carried by river were felt. The various points of contact that this problem has with the different facets of human activities have been carefully examined by different workers. In this note, the effect of sedimentation on the useful life of reservoir has been examined carefully with the help of detailed investigations undertaken by the author.

## 5. Particle size determination through settling processes.

H. R. PRAMANIK, Calcutta.

Estimation of size of particles of sediments is a matter of interest to Engineers, Geologists and Mineralogists alike. The most convenient way of such estimation for fine sediment is to subject such sediment samples to a process of settlement through a fluid medium which effects a separation into different groups according to the size of the particles. Use is made of Stoke's law to calculate the effective size of each particle or group of particles. Stoke's law holds for spherical particles moving with uniform velocity in an infinite fluid medium under the primary influence of viscous forces. Particles of sediments, however, are not usually spherical nor are they allowed to fall in an infinite fluid medium free from interference of any neighbouring object inside the medium. In order therefore to interpret correctly the results of such sedimentation experiments, it is necessary to know

- (1) how the proximity of the boundary containing the fluid affects the velocity of fall of particles,
- (2) how the shape of a non-spherical particle affects the velocity of fall,
- and (3) how the concentration of sediment suspension affects the velocity of fall.

These problems are not easily amenable to mathematical treatment. A series of experimental studies, supplemented wherever possible by mathematical analysis, was initiated a few years ago at the Iowa Institute of Hydraulic Research on the above three problems and a number of research workers, of which the author of this paper was one, have already worked on these problems. Individual completed work of each research worker has in most cases been published by him separately. The author of this paper attempts to review the complete series of work done so far, including that of his own, on the problems (1) and (2) above so as to present the results in a complete and comprehensive form to the reader.

## 16. Correlation of analysis of soils by standard sieves and sedimentation.

S. N. SARKAR, Calcutta.

The mechanical analysis of soils is indispensable for quite a large number of purposes. There are again several methods of analyses in use. And the most general practice for mechanical analysis of soils involves the use of a set of standard sieves for the coarser range followed by sedimentation method based on Stoke's law for the finer fractions. But the relation between the results of sieve and sedimentation analyses is not accurately known. Attempt has been made to find the correlation, if any, between the two. Stress has been laid on the magnitude of the differences arising out of such analyses separately by both these methods. The importance for using an effective size scale continuous through the silt and sand ranges has also been pointed out.

The experimental part of the work consists of analysis of a number of soil samples both by Puri Siltometer as well as a set of standard sieves. The sp. gr. of soil samples has been determined and corrections introduced into the results of analysis by Puri Siltometer. Stoke's diameters were also corrected after Zalm for inertia effects to give the so-called equivalent diameters. Results of analysis are



presented in a tabular form. Statistical analysis of these results reveals a straight line relationship and a high degree of correlation ( $r=0.996$ ) has been obtained.

### 17. Study on dispersion of clay with different chemical reagents.

P. ROY, Calcutta.

For determination of particles size distribution of soils use has long been made of chemical reagents for effecting a dispersion of soil particles. The usual standard method so long followed is the use of caustic soda as defloculating agent after pretreatment of the soil with N/5 hydrochloric acid. The use of acid has been subjected to criticisms, as a result, attempts were made to find out a most suitable dispersing agent for effective dispersion and maintaining a stable suspension at the same time and to find out relative advantages of different reagents used as defloculating agents, also their nature and amount for effective dispersion. Reagents used in this laboratory for the purpose were (a) sodium-meta-silicate, (b) sodium-oxalate, and (c) sodium-hexa-meta-phosphate.

For this purpose non-calcareous soil samples of West Bengal containing mainly clay and silt were selected, the clay percentage having been previously determined by the standard caustic soda process after treatment with hydrogen peroxide and hydrochloric acid.

It is found that the maximum percentage of clay obtained by using sodium oxalate almost corresponds to that obtained by the standard caustic soda process whereas sodium-meta-silicate gives a lower value and sodium-hexa-meta-phosphate an unusually high value. It is now being investigated why sodium hexa-meta-phosphate gives such high values for percentage of clay.

### 18. Rural Electrification.

M. DATTA, Calcutta.

The Government is now seriously considering the provision of a supply of electricity to be at least partly in the nature of a social service. Account must be taken of the indirect benefit which may be expected to accrue to agriculture and the general well-being of the rural population from the provision of this service. By placing cheap motive power in the hands of country dwellers and rural cultivators, the general standard of living may ultimately be raised and in turn demands for energy supplies for the less remunerative areas will be stimulated. To accelerate the development certain special considerations were suggested for decreasing the capital cost for extension of the lines to unremunerative areas.

It is suggested that consideration may be given to the following :—

(a) Advantage of single phase lines as an alternative to the usual 3 phase system in the development of sparsely populated areas.

(b) Combined H.V./L.V. construction in the manner used abroad may be used with advantage without the use of any further cradling arrangement unless special conditions are encountered at points where cradle should be used.

(c) It is recommended that the size of transformer used for rural electrification be standardized in order to keep down the system of loss to a minimum. More or less standard size of single and 3 phase transformers should be 15 KVA and 25 KVA respectively with the qualification that 5 KVA single phase units should be available for special instances.

(d) The A.C.S.R. Conductor will be most suitable for rural electrification in view of the fact that long span and high tension fewer and shorter poles can be employed.

(e) The loading conditions adopted by the different Indian State Governments has been considered irrational and further consideration should be given to the

duction in line costs by adoption of the proposed amended regulation contained the British Overhead Line Regulations E.L.C. 53 (1947 Revised).

(f) When planning regional electrification for our country it is necessary to consider the appropriate local, climatic and geographical conditions. The loading conditions in our country are less severe than in Britain but there is also less difference between the loaded and unloaded condition. As the present method of calculating the factor of safety of the lines with load at minimum temperature when Conductor stress is high is very uneconomical. Suggested modifications by the author for calculation for sag and tension whereby economies in overhead transmission line construction can be achieved should be considered. For low voltage distribution the use of multi-point neutral earthing system as has been used in Madras should be profitably utilized.

#### 19. "Harmonic Elimination Equipment."

J. K. CHOUDHURY and S. C. DAS GUPTA, Calcutta.

An equipment has been designed to eliminate the chief harmonic contents of an ordinary commercial A.C. supply to give a pure sine-wave voltage for tests carried out in Electrical Measurements and Standardisation laboratories. It is well known that commercial A.C. supplies are distorted to some extent and though suitable for general laboratory purposes, are not desirable for Measurements and Standardisations. Special costly equipments e.g. sine-wave alternator, valve oscillators give sine-wave supply necessary for these. The "Harmonic Elimination Equipment" designed by the authors is capable of eliminating the harmonic contents and thereby improving the wave-form of an ordinary mains supply. In this equipment the principal harmonic contents are filtered out from the mains supply and are injected back into the mains in proper magnitude and phase such that they cancel out the respective harmonics in the mains and hence a practically sine-wave supply is obtained.

#### 20. Vertical Polar Diagrams of an Ultra-short Wave Horizontal Dipole Aerial.

S. S. BANERJEE and P. C. BANERJEE, Banaras.

Vertical polar diagrams of dipole aerials are usually drawn which are applicable for long distance broadcasting purposes. The field-strengths near the transmitting aerial are, however, neglected as they are generally not of much importance for long distance transmissions at lower frequencies. For communications on ultra-high frequencies, however, the field-strength is reduced considerably quickly with distance, and as such, it is necessary to know the shape of the vertical polar diagrams even at short distances. In the present communication mathematical equations have been deduced for drawing the polar diagrams in the neighbourhood of a horizontal dipole aerial. Incidentally it has been shown how such polar diagrams are affected if the aerial is kept under the ceiling made of reinforced concrete materials. It has been further shown how these modified polar diagrams can be used for the computation of the dielectric constant and conductivity of such building materials.

#### 21. Atmospheric Noise Level in the 5 Mc/s Band at Poona.

S. V. CHANDRASHEKHAR AIYA and K. R. PHADKE, Poona.

Systematic measurements of atmospheric noise have been taken for the whole year, at 4.7 Mc/s for the period, 18 to 24 hours I.S.T. by a method previously reported elsewhere. The paper gives an analysis of the data with a possible theoretic-



tical interpretation. The results are compared with values to be expected from noise grade maps and by the method of Thomas. Service values for any continuous service for the four quarters of the year are given. As there was interference at 5 Mc/s, measurements were taken as near this frequency as possible and this was 4.7 Mc/s. A report is also made of the insurmountable difficulties caused by interference. A possible Correlation to thunderstorm data as published by one of us is indicated.

## **22. Atmospheric Noise level in the 10 Mc/s Band at Poona.**

S. V. CHANDRASHEKHAR AIYA and C. K. SANE, Poona.

Systematic measurements of atmospheric noise was carried out at 9 Mc/s as there was interference at 10 Mc/s. for the whole year, 1954 for the period of day, 18.00 to 24.00 hours I.S.T. The paper gives an analysis of the data and its correlation to thunderstorm data. Values for the four periods of the year for continuous service have been computed. A feature of the paper is prominent abnormalities due to thunderstorm areas going into the skip. Difficulties of making correct assessments during the winter months are also pointed out.

## **23. Atmospheric Noise level in the 1 Mc/s Band at Poona.**

S. V. CHANDRASHEKHAR AIYA and C. G. KHOT, Poona.

A special type of noise meter was actually designed and built in the laboratory to meet the requirements of noise measurements in the medium frequency band and a special aerial and counterpoise installation was put up by one of us (CGK). This is described in the paper. Measurements were systematically taken with this equipment for the latter half of 1954. The paper gives also a report of the results, their analysis etc. pointing out at the same time the insurmountable difficulties of measurement in the medium frequency band.

## **24. Field strengths of fading signals in the Tropical Short Wave Broadcast Bands.**

S. V. CHANDRASHEKHAR AIYA and R. D. JOSHI.

A feature of secondary regional short wave broadcasts in the 3 and 5 Mc/s bands is that a horizontal dipole is used and its height is so adjusted that there is profuse upward radiation at all angles. For assessing the field strengths of such stations in relation to noise, it becomes necessary to find out how a long or short period assessment varies with the type of receiving antenna used. For this purpose, horizontal and vertical aeriels were both employed and systematic measurements carried out. A most interesting conclusion is obtained and that is that the type of antenna employed has really no significance and that within certain limits the field strength is the same. The paper further gives the basis for the experiments and the procedure to be adopted.

## **25. Predicted and observed critical frequencies for $F_2$ region of the ionosphere.**

S. S. BANERJEE and J. P. SRIVASTAVA, Banaras.

A detailed comparative study of the predicted and observed values of the critical frequencies for  $F_2$  region of the ionosphere has been made from the Ionospheric data compiled by the Research Department, All India Radio, Delhi. The above study shows that there is generally a large discrepancy between the observed and predicted critical frequencies, and further, the predicted values are usually found to be greater than the observed ones. It may be mentioned that for these

discrepancies the predicted critical frequencies have often to be used with much reservation for practical radio communications. It is known that the predictions are based on the ascending or descending trends of the sun-spot numbers in the eleven years solar sun-spot cycle which are applied to the observed values of the critical frequencies prior to the period of utilization of the predicted values. In the present communication we have shown that the predicted critical frequencies agree more closely with the observed values if both the ascending and descending trends of the sun-spot numbers in the solar cycle are taken into account. It is also known that the predicted critical frequencies obtained by the above method are found on many occasions to be even slightly lower than the observed values which make the predictions more suitable for the use of the Radio Engineer.

#### **5. Resistance of Electrical Wires at Ultra-high Frequencies and its Effect on the Measurement of Wavelength by Lecher Wires.**

S. S. BANERJEE and T. V. S. MURTY, Banaras.

The wavelength of an ultrashort wave oscillator as measured with a pair of Lecher wires is found to decrease when the diameter of the wire is sufficiently increased. This is presumably due to the reduction of velocity of the wave traveling along the parallel wires owing to the high resistance of these wires at ultra-high frequencies. In order to check up the results the high frequency resistance of the wires has been calculated from the value of the phase constant and it has been shown that this resistance is much higher than that obtained from the modified Kelvin's relation between the high frequency and D.C. resistance of such electrical wires. The increase of resistance with diameter calculated from phase constant is also in contrary to the variation of resistance expected from the above earlier relation. It has been further observed from the resonance curves drawn at the current antinodes formed on the Lecher wires made of copper, brass and galvanized iron, that although the high frequency resistance increases with diameter, the radiation resistance of the system does not show any increase and rather it has a tendency to decrease when the diameter of the wire is increased. As a result of this, the attenuation constant is also found to decrease with diameter. The limitation in the diameter of the wires to be used for the measurement of wavelength by a pair of parallel wires is therefore indicated.

#### **27. The Distance of Scattering Centres on the Ground for Maximum Intensity of Scattered Radio Signals.**

S. S. BANERJEE and D. K. BANERJEE, Banaras.

It has now been realized that under suitable ionospheric conditions it is possible to establish radio communication between two distant stations at a frequency higher than the calculated maximum usable frequency by means of scattered signals. The reception of scattered signals from the ground, however, has been found to depend mainly on the focussing effect produced by the thickness of the ionospheric layer. Whenever the focussing is more pronounced, scattered signals of appreciable strength are observed even with low power transmitters. When the electronic density in the ionosphere continually decreases the ordinary and extraordinary rays successively disappear and the disappearance of the extraordinary ray is followed by the reception of scattered signals. As the point of reflection in the ionosphere moves away from the transmitter due to the lowering of the electronic density or the increase of the frequency of transmission, the intensity of scattered signals increases in the beginning and then falls. This phenomenon of initial rise followed by gradual fall of intensity of scattered signals has been explained by the fact that



the focussing effect due to the ionospheric layer of a given thickness attains a maximum value at a particular distance from the transmitter. It has been shown mathematically that both for vertical and oblique incidence, as the distance of scattering centres from the transmitter increases the concentration of energy of radiated signals toward the ground increases rapidly and then falls asymptotically. The distance of the scattering centres from the transmitter for maximum focussing effect has been calculated and verified by experimental observations with a low power pulse transmitter for vertical incidence and also with high power transmitters for oblique incidence.

## **28. The Angle of Arrival of Scattered Radio Signals from the Ionosphere and the Location of the Scattering Centres on the Ground.**

S. S. BANERJEE and D. K. BANERJEE, Banaras.

It has now been conclusively shown that most of the scattered radio signals have their sources situated on the ground. The distances of such scattering centres from the receiving station were determined from the angle of arrival of the scattered signals through the ionosphere which was measured by the 'phase difference' method with two vertically spaced horizontal dipole aerials, connected to two identical super-heterodyne receivers, with a common beat oscillator, designed and constructed for the purpose. The outputs of the receivers were applied to the two pairs of the deflecting plates of a cathode ray oscillograph and the phase difference was calculated from the ratio between the minor and major axes of the elliptic patterns obtained on the oscillograph screen.

It has been shown from the nature of the east-west horizontal gradient of ionization in the ionosphere and the polar diagram of the transmitting aerials, that in the evening hours the scattering centres lie on the west of the receiver at Banaras for observations made with the transmissions from Delhi, and in the morning hours they should lie on the eastern side at a distance of about 2180 Km. This gives the location of the scattering centres somewhere near the Hindukush mountains on the west of the receiver and over the Bay of Bengal on the east. It has been further observed that the intensity of the scattered signals is generally higher in the morning hours than in the evening, presumably due to the greater reflecting coefficient of the sea water.

## **29. Power in India during the Last Half a Century.**

J. N. BASU, Calcutta.

Nature has abundantly favoured India with different sources of power generation. She has enough coal reserve to last 600 years at the present rate of consumption. She harnessed only 3% of her water power resource of 25 million K.W. She has a vast potential wind power to the extent of 750 million K.W., practically wholly unused at present. There are possibilities to develop power from solar energy as well as from atomic energy. She has, no doubt, deficiency in petroleum products; she attempts to make up for this by establishing 3 oil refineries and one synthetic petrol plant. Besides she produced in 1952, 4 million tons of power alcohol from molasses and she can produce 20 million tons from molasses alone.

In spite of natural fortunes, she is very deficient in power consumption. The energy index in India is only 18 whereas that of Canada is 4000, U.S.A. 3200, Sweden, Switzerland or Norway—2000, Germany—1250, U.S.S.R.—300 and U.K.—1100. The energy index is a significant indicator of economic, social and industrial position and of material development and standard of living of the people of the country.

Upto 1900 India had very poor power generation. The Calcutta Electric Supply Corporation commenced supply in 1899 with 1000 K.W. plant, and the Darjeeling Municipality erected in 1892-98 a hydel plant of 130 K.W.; total generating capacity in 1900 was only 1130 K.W. From 1900 to 1920, the total installed capacity from steam, oil and hydel went slowly upto 130,009 K.W. Thereafter the power development began to shoot off, mainly due to extensive industrial development in the country after the First World War. The installed capacity rose to 1,200,000 K.W. in 1939 (steam—620,000 K.W., oil—115,000 K.W., hydro—465,000 K.W.). There was a lull in the increase during the first few years of the Second World War, but from 1942, it again began to grow up, the installed capacity rose to 1,835,426 K.W. (steam—97,567 K.W., oil—162,680 K.W., hydro—575,179 K.W.) by December 1951, the first year of the First Five Year Plan. The electricity generation grew from 250 million K.W. to 5858.4 millions K.W.; 47.4% of this is from steam, 3.8% from oil, and 48.8% from hydro. The installed capacity of hydel is 52.34% of steam, but units generated from water power is 102.8% of steam. This indicates less use of coal and more use of water otherwise wasted.

The power generation is not only poor but its distribution is greatly unbalanced between urban and rural areas. Cent per cent of towns in India with population 50,000 and above are supplied with electricity, 90% of towns with 20,000 to 50,000 population, 48% of the towns with 10,000 to 20,000 people and 15% of towns with 1000 to 10,000 population have the benefit of electricity, whereas only 10.5% of the localities mainly villages with population 5,000 or below can avail themselves of electricity. Out of 560,000 villages in Indian Union only 3,000 villages mainly in the States of Mysore, Madras, U.P. and East Punjab are served with electricity.

Cheap power is essential for the development of not only industries, but also agriculture, cottage industries, dairy farming, food processing and many co-related activities, to increase wealth of the land, to reduce unemployment and to promote social welfare.

During the first Five Year Plan, 600 crores are allotted to be spent for irrigation and power; the projects are calculated to irrigate an additional acres of 8.8 million acres and to generate 1.8 million K.W. of additional power in the last of the plan and to irrigate 16.5 million acres and to power 1.935 million K. W. on completion.

## 10. Study of a Non-Linear Magnetic Circuit.

Mr. R. B. JOSHI and Dr. S. M. SEN

In this paper a study has been made of a Non-Linear Circuit using magnetic cores. The Non-Linear Circuit—a simple R—L circuit is studied here both theoretically and experimentally. The study is based on the straight line approximation which takes into consideration, the two straight line regions, one unsaturated and the other completely saturated. The newly developed ferro-magnetic core characteristics justify the assumption of such straight line representation of magnetisation characteristics.

The agreement between the calculated and measured values of the current is quite satisfactory considering the fact that the actual magnetisation characteristics differ from the magnetisation characteristics assumed for analysis. The salient feature of this analysis is that it shows theoretically (which is also verified experimentally) the four definite transitions which take place in one cycle along with the transients, that are generated during two of these transitions from saturated to unsaturated conditions of the core.



**31. An Accurate System of Measuring an Interval of Time.**

P. KUNDU, Kharagpur.

An accurate system of measuring an interval of time has been developed by utilising the transient growth of voltage across a capacitor. The conventional use of Pentode with its inherent source of error due to the assumption of linear charging have been eliminated by using a simple resistance and by taking the exponential nature of the time variant voltage into account. The value of  $t'$  has been calculated from the measured values of different parameters. All these parameters have been measured in terms of voltages and, as a result, very high order of accuracy can be obtained by using potentiometric arrangement. The method of finding CR as shown here, can be used in determining the dielectric constant and loss angle of any material.

This system has been developed for some Physico-Chemical measurements such as Viscosity, gravity, Chemical relation time etc. The accuracy of this system has been experimentally verified by measuring gravity 'g' by a falling ball method and the value obtained agrees quite well with the known value of 'g'.

**32. On Dephosphorisation of White cast Iron in Hydrogen.**

B. CHATTERJEE, Sibpur.

The removal of phosphorus, if any, from block (15 mm.  $\times$  8 mm.  $\times$  8 mm.) as also powdered samples prepared from a specimen of white cast iron (Mn., 0.58%; Si, 0.89%; P, 0.67%; and S, 0.47%) on heating at 1000°C for 8 hours in a current of moist hydrogen has been studied. Metallographic examination revealed that the phosphorus was present in the component known as steadite. No dephosphorisation could be observed with either the block or powdered samples. These results in conjunction with those reported previously, viz., that no dephosphorisation could be observed on heating at 1000°C small blocks prepared from a specimen of cast iron (C, 3.08%; Mn., 0.216%; Si, 0.88%; P, 0.21% and S, 0.10%) in a current of hydrogen containing 1.20 per cent by volume of moisture whereas the phosphorus content of powdered samples of a ferrophosphorus (P, 26.60%) was reduced by 34.60 per cent under identical conditions, suggest that (i) the non-removal of phosphorus by hydrogen from cast irons used cannot be ascribed solely to the low diffusibility of the reactants and (ii) the composition of the alloy seems to play an important role in the dephosphorisation reaction. Further work on the effect of phosphorus content of cast iron on the dephosphorisation of the latter by hydrogen is in progress.

**33. On the Hysteresis of Tube Oscillator.**

DR. KALYAN KUMAR BOSE, Kharagpur.

Normally the feedback necessary to start oscillation in a vacuum tube oscillator is the same as that necessary to prevent oscillation, analogous to the melting and freezing point of water. But in certain regions of the characteristic curve of the tube, depending on the initial grid-bias, the two feedback values differ considerably. Oscillations once started in the latter case are maintained even when feedback is reduced to a value considerably less than that which started the oscillation. The difference between the two feedback values will depend on the bias of the system. This phenomenon, known as "Oscillator hysteresis" has been explained by a mathematical treatment, in which it has been shown that the sign (+ve or -ve) of the third and fifth differential coefficients of the mutual characteristic curve are responsible for this phenomenon. When they are positive, hysteresis will appear and

When negative the system will be normal, neglecting the effect of grid current. The grid current may bring a normally stable operated oscillator into an unstable condition with the appearance of hysteresis, because it alters the theoretical analysis.

#### 4. Signal analysis and audio characteristics of Pulse-slope Modulation.

JAJNESWAR DAS, Kharagpur.

##### *Abstract.*

The Fourier analyses of different processes of P.S.M. and the experimental determination of its audio-frequency characteristics has been made. The maximum modulation possible is seen to be dependent on the bandwidth and the pulse-rate of the system, and is of the order of 80 to 90 per cent for general cases. The process of demodulation requires the use of a differentiator and a 'Boxcar' pulse-lengthener circuit. The differentiated signal consists of very sharp pulses which are simultaneously amplitude-modulated and width-modulated. The 'Boxcar'-pulse-lengthener circuit is used to eliminate the width modulation.

Experimental verification with a P.S.M. system of P.R.F.=10Kc/s and pulse-duration=10 microseconds shows that the modulation is linear over an input audio volume-range of 35 dB. The audio gain of the complete system is fairly constant upto 3Kc/s with a variation of  $\pm 5$  dB only. The average distortion is within 5% for a volume variation of 30 dB at the input. Distortion is higher with very low as well as very high input level due to the nonideal response of the audio amplifier and the pulse-lengthener circuit. The overall characteristic compares well with other pulse-modulation systems. Finally, it is seen that, with proper equaliser, ideal audio-filter and amplifier, the distortion in P.S.M. can be minimised almost zero.

#### 5. Some Diode-gating Techniques for Obtaining Decade Scaling from Binary Scalars.

R. PARSHAD and S. K. SINGH, New Delhi.

Various new diode-gating techniques are introduced for conversion of four-stage binary counters to decade scalars. The essential difference between the previous arrangement and the present is that in the former, advance of count is done when a single binary stage attains a particular state and in the latter the advance of count is done when the scaler as a whole is in a particular state. The present techniques vastly increase the number of decade-schemes possible. As an example, whereas previously there was probably only one decade-scheme which was fast and had decade interpolation, with the present techniques twelve such schemes have been made.

The decade-schemes are stable in operation, and non-critical of adjustment.

#### 6. Studies on the Nature and Distribution of Mineral Matter in Indian Coals.

PARIMAL SEN and A. N. ROY, Kharagpur.

In the course of studies on the beneficiation of various Indian Coals of high ash content it was found important to investigate into the nature and distribution of mineral matter in the body of the coal substance. As an essential step, initial experiments were carried out to determine the mineral matter distribution in various sizes fractions of coal which were prepared by crushing and screening. It has been of interest to find that there was considerable difference in the mineral matter content in the different fractions and the general trend was decrease in ash content from coarser to finer size fractions. Of the four typical coals studied



the variation in ash distribution was—in Bokaro coal (ash 32.5%) from 34.5% in sizes above 5 mesh to 21% in 25 to 52 mesh size ; in Digwadi grade III B coal (ash 30.45%) from 36.7% in sizes above 5 mesh to 25.3% in 25 to 52 mesh ; in Jamadoha middlings (ash 28.5%) from 30.1% in sizes above 5 mesh to 150 mesh ; and in a Jharia coal sample (ash content 26.5%) from 30% in above 5 mesh sizes to 20% in 52 to 150 mesh size. In extreme fines below 200 mesh, however, a slight increase in ash content was noticed.

The nature of the mineral matter and the extent of petrographic separation in various fractions have also been investigated by chemical and X-ray analysis.

### 37. Utilisation of Waste Mica, Part II.

DR. K. K. MAJUMDAR, Dhanbad.

In an earlier paper, the author described a method for preparing grit free mica, free from impurities, and grinding it wet to produce products suitable for lubricants and paints. In that method a large quantity of impure mica, all minus 8 mesh, is produced. This mica has been subjected to froth flotation with a view to remove all the associated impurities. It has been found that in a mechanically agitated flotation cell, the mica can be easily floated away from its impurities by both anionic and cationic collectors. Oleic-linoleic acid mixture (Armour & Co.) has been found excellent as a collector and frother. ARMAC TD (Armour & Co.) which is Tallow Amine Acetate is also an excellent collector for mica. Cresylic acid is an excellent frother but, contrary to published reports, it has no collecting power for muscovite mica of mica fields in Bihar. The product obtained by flotation is also suitable for conversion into lubricant and paint quality by wet grinding, described in the earlier paper.

### 38. X-ray diffraction studies of Carbon Steel samples super-saturated with hydrogen.

K. C. SOM and G. P. CHATTERJEE, Calcutta.

On cathodic surcharging hydrogen can be occluded in iron and steel in amounts far in excess of ordinary solubility and therefore the metal becomes supersaturated. Some investigators believe that iron neither forms hydride nor any true solid solution with hydrogen because X-ray diffraction studies neither show the presence of any new line nor any displacement of the original lines. Moreover, electrical resistance is not much affected on occlusion. Chemical combination is hardly possible without affecting the conduction electrons.

X-ray diffraction studies have been done by others after surcharging. No work has been done during surcharging. An attempt has been made in this paper to study the X-ray diffraction pattern of carbon steel samples during surcharging. A simple device has been arranged so that the sample can be rotated and surcharged and at the same time exposed to a collimated X-ray beam from cobalt target. The X-ray diffraction patterns before and during surcharging have been taken in this way on the same film. A displacement of the line is distinctly evident for a sample surcharged for 18 hours. The lattice parameter corresponding to the displaced line has been found to be 2.872 Å.

### 39. Changes in Thermoelectro-motive Forces on Low Temperature Tempering of Quenched Steel Samples.

J. K. MUKHERJEE and G. P. CHATTERJEE, Shibpur.

A quenched sample of carbon steel consists of martensite with or without retained austenite and fine pearlite depending on composition, rate of cooling and other factors,

No matter how the different unstable non-equilibrium phases transform to the stable equilibrium phases there could be no question that changes in electrical properties (electrical resistivities and thermoelectromotive forces) and probably vibration damping capacities (internal friction) would occur in measureable magnitude much before any other changes either in structure (detectable by X-rays, optical or electron microscope) or in other mechanical properties like hardness or strength. An attempt has been made in this paper to study the changes in the thermo e.m.f. values of quenched samples of carbon-steel on tempering at comparatively lower temperature (50°C and 75°C) for different periods of time.

The following results have so far been obtained :

- (1) the thermo e.m.f. values of constantan-steel couples increase on quenching ;
- (2) with increasing time of tempering at a given temperature the thermo e.m.f. values decrease (compared to those of quenched samples) for tempering at 75°C and 50°C ;
- (3) in the case of tempering at 50°C the e.m.f. time plot shows a minimum followed by a maximum and then a comparatively rapid drop ;
- (4) in the case of tempering at 75°C the trend is similar to the case of 50°C except that the minimum and maximum occur at different periods of times.

#### 40. Thermodynamics of Interfaces between Metallic Crystal Grains.

G. P. CHATTERJEE, Shibpur.

Phenomena at interfaces between metallic crystal grains play fundamental role in recrystallisation, grain growth, quenching, tempering, ageing, grain boundary precipitation, intercrystalline corrosion, temper brittleness and a host of other allied phenomena in the treatment of solid metals and alloys. For several reasons studies on interfacial phenomena from the point of view of thermodynamics are rather difficult, particularly for metals and alloys where, apart from the difficulties of getting equilibrium conditions, complications arise due to variable orientations of neighbouring grains in a polycrystalline material and also different diffusion coefficients for the same atomic species within the grain and at or near the grain boundary. Under certain simplified assumptions an attempt has been made in this paper to develop a few simple relations between temperature, surface tension and composition of homogeneous binary alloys leading ultimately to the relation

$$\frac{\delta}{\delta T} \left[ \frac{\sigma_{\eta_2}}{x_2} - \frac{\sigma_{\eta_1}}{x_1} \right] = \frac{1}{RT} \left[ \frac{1}{T} \left( \frac{\delta \gamma}{\delta x_2} \right)_{T,P} - \frac{\delta}{\delta T} \left( \frac{\delta \gamma}{\delta x_2} \right)_{x_2,P} \right]$$

where  $\sigma_{\eta_1}$ ,  $\sigma_{\eta_2}$  are moles per unit area of solvent and solute atoms at the interface of the grain,

$x_1$ ,  $x_2$  are mole fractions of solvent and solute within the grain,

$\gamma$  is surface tension,  $T$  is temperature in °K

$R$  is gas constant and  $P$  is pressure.

Determination of  $\gamma$  as function of  $x_2$  at different temperatures enables one to find the value of the right hand side of the above equation. If this gives a positive

value,  $\frac{\sigma_{\eta_2}}{x_2} > \frac{\sigma_{\eta_1}}{x_1}$  and thus there is preferential segregation of solute atoms prior

to precipitation at the grain boundary. If, however, the value be negative there will be a tendency for solute atoms to segregate within the grains prior to or leading to precipitation. Other possibilities and suggestions have been indicated.



**41. Amplitude decay characteristics of damped vibrations in metallic materials.**

G. P. CHATTERJEE, Shibpur.

The differential equation for a free torsional vibration under a damping force is usually written as

$$I \frac{d^2\theta}{dt^2} + R \frac{d\theta}{dt} + K\theta = 0. \quad (1)$$

where  $I$ =moment of inertia,  $R$ =resistance constant and  $K$ =torque constant. It is tacitly assumed in equation (1) that the damping force is of a viscous type and is

therefore proportional to  $\left(\frac{d\theta}{dt}\right)$ . This is generally not true because the damping

force is in general some function of  $\frac{d\theta}{dt}$  and represented as  $\phi\left(\frac{d\theta}{dt}\right)$ . Similarly the restoring force is in general not proportional to  $\theta$  as indicated in equation (1). If stress had been proportional to strain a stress-cycle would be linear and there would be no damping. The phenomenon of microplasticity in metals and alloys and also the fact that metals and alloys exhibit vibration damping even under very small stresses, imply that the conventional linear relationship between stress and strain does not hold good even under vanishingly small stresses. The restoring force is therefore some function of  $\theta$  and the differential equation written as

$$I \frac{d^2\theta}{dt^2} + \phi\left(\frac{d\theta}{dt}\right) + f(\theta) = 0 \quad (2)$$

Equation (2) is non-linear and has no generalised solution. The decay of amplitude  $A$  as function of time  $t$  expressed by the relation

$$A = A_0 e^{-\frac{R}{2I}t} \quad (3)$$

is based on equation (1) and therefore does not truly represent the amplitude decay characteristics of many metallic materials. An attempt has been made in this paper to discuss the amplitude decay characteristics on the basis of a simple relation between the damping amplitude and the energy lost in the preceding stress-cycle. This leads to the equation

$$A = A_0 \left[ 1 - \frac{(n-2) R t}{2 I} \right]^{\frac{I}{n-2}} \quad (4)$$

Experimental decay curves tend to conform more to (4) than to (3). Moreover, for the special case of  $n=2$ , it may be easily shown that equation (4) leads to (3) and therefore covers the case of exponential decay of amplitude under viscous damping.

**42. Studies on the Ionic Nature of Molten Alloys with Particular Reference to Al-Si Alloys.**

S. S. PANI and G. P. CHATTERJEE, Shibpur.

In any molten binary alloy the constituents may be present as atoms or ions or both. The degree of ionisation of the atoms depends on temperature and the nature of the solvent and solute. While some work has been done on amalgams and other alloys, no systematic work has been done on binary alloys, one constituent of which is comparatively more electronegative as in Al-Si, Cu-P, Fe-P or Fe-C alloys. An attempt has been made in this investigation to study the behaviour of Al-Si alloys in the molten condition under a D.C. electric field. It has been found that Si remains in an ionised condition in molten Al-Si alloys and migrates towards the anode on the application of a D.C. electrical potential. X-ray diffraction studies of samples from anode and kathode show distinct shift of

the lines. The lattice parameter values of the anode-samples are larger than those for the kathode samples.

#### 43. Vibration Damping Characteristics of some Typical Metals and Alloys.

K. C. SOM, A. K. LAHIRI and G. P. CHATTERJEE, Shibpur.

The vibration damping capacity of a material is the amount of energy lost per unit volume of the material in one stress-cycle. Under viscous damping and assuming that the restoring force is proportional to strain one gets an exponential decay of amplitude.  $A$  given by

$$A = A_0 e^{-rt} \quad \dots \dots \dots (1)$$

where  $t$ =time and  $r$  is half the damping force per unit velocity for unit mass or moment of inertia. Apart from exponential decay equation (1) may explain a linear decay provided  $r$  is small. But it is difficult to explain linear decay characteristics when  $r$  is large. On the assumption that

$$\Delta W = kA^n \quad \dots \dots \dots (2)$$

where  $\Delta W$  is the energy lost per cycle and  $A$  is the amplitude and  $n$  is any positive number (integral or fractional) an attempt has been made in this paper to explain some of the typical decay characteristics of alloys. If  $\Delta W$  be proportional to  $A$  (as in coulomb damping) or to  $A^2$  (as in viscous damping) it is necessary to assume that  $r$  is small to explain a linear decay. If however  $\Delta W$  be proportional to  $A^3$  one gets a linear decay no matter whether  $r$  is small or large. A few other possibilities have been discussed for metals and alloys under different conditions.

#### 44. Studies on South Arcot Lignite.

M. R. BASU and H. N. DAS GUPTA, Dhanbad.

The present communication embrace the results of an investigation made with a view to ascertaining the feasibility of using the Arcot lignite for the reduction of iron ore to pig iron. The problem by itself is a complicated one, as this involves the use of a non-caking fuel. However, definite indications have been obtained which go to show that a mixture of the ore, suitably dried lignite and flux, when properly pressed and subjected to a high temperature, yields pig iron. The chemical composition of pig iron may be varied by altering the conditions of firing and of the initial mixture. The stability of the briquettes prepared from the above mixture with a binding material depends on the initial moisture content of the lignite and on the chemical nature of the added bond.





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26th "	1939,	Lahore	...	...	...	...	20	0	0
27th "	1940,	Madras	...	...	...	...	27	6	0
28th "	1941,	Banaras	...	...	...	...	30	4	0
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30th "	1943,	Calcutta	...	...	...	...	19	8	0
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